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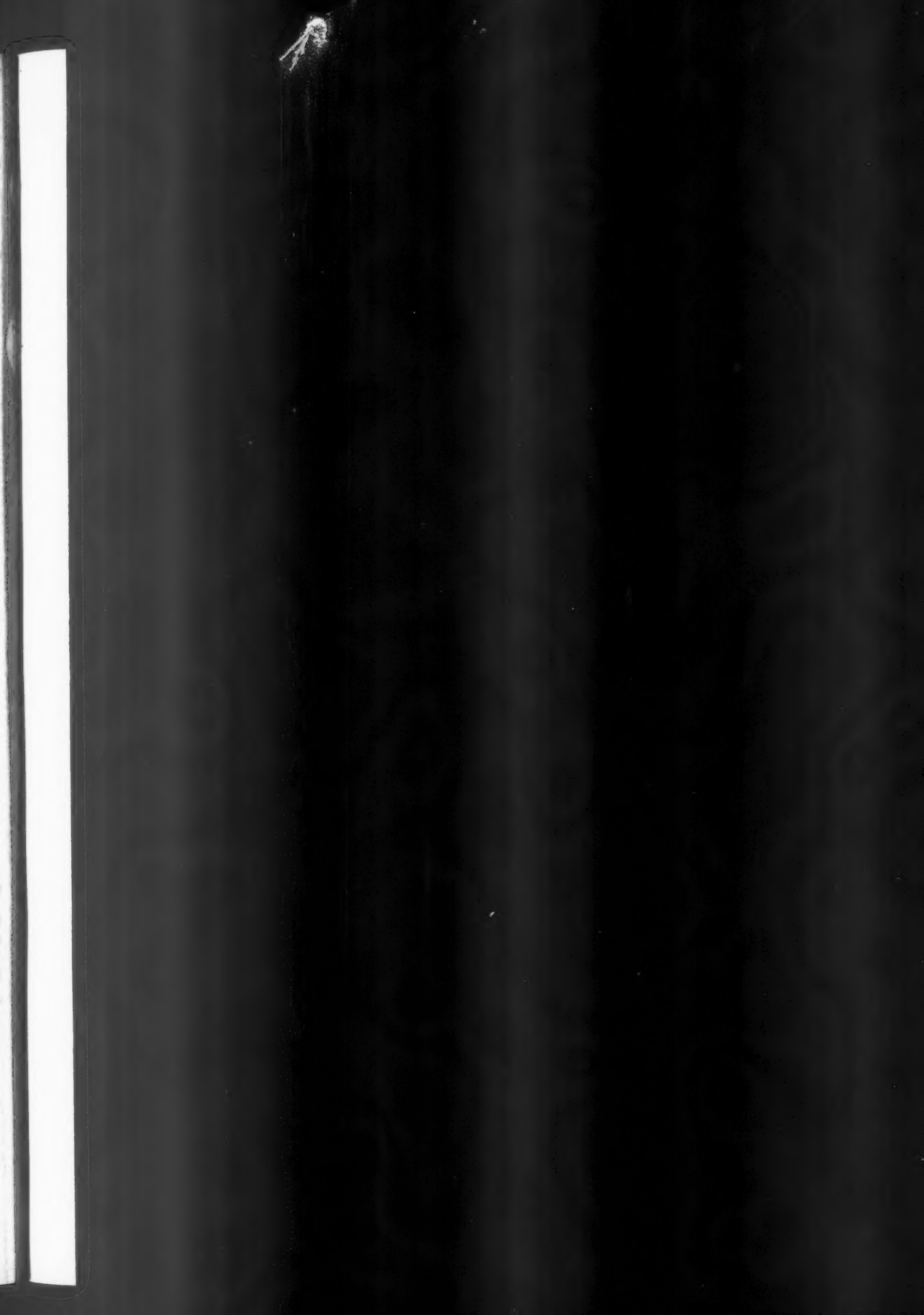
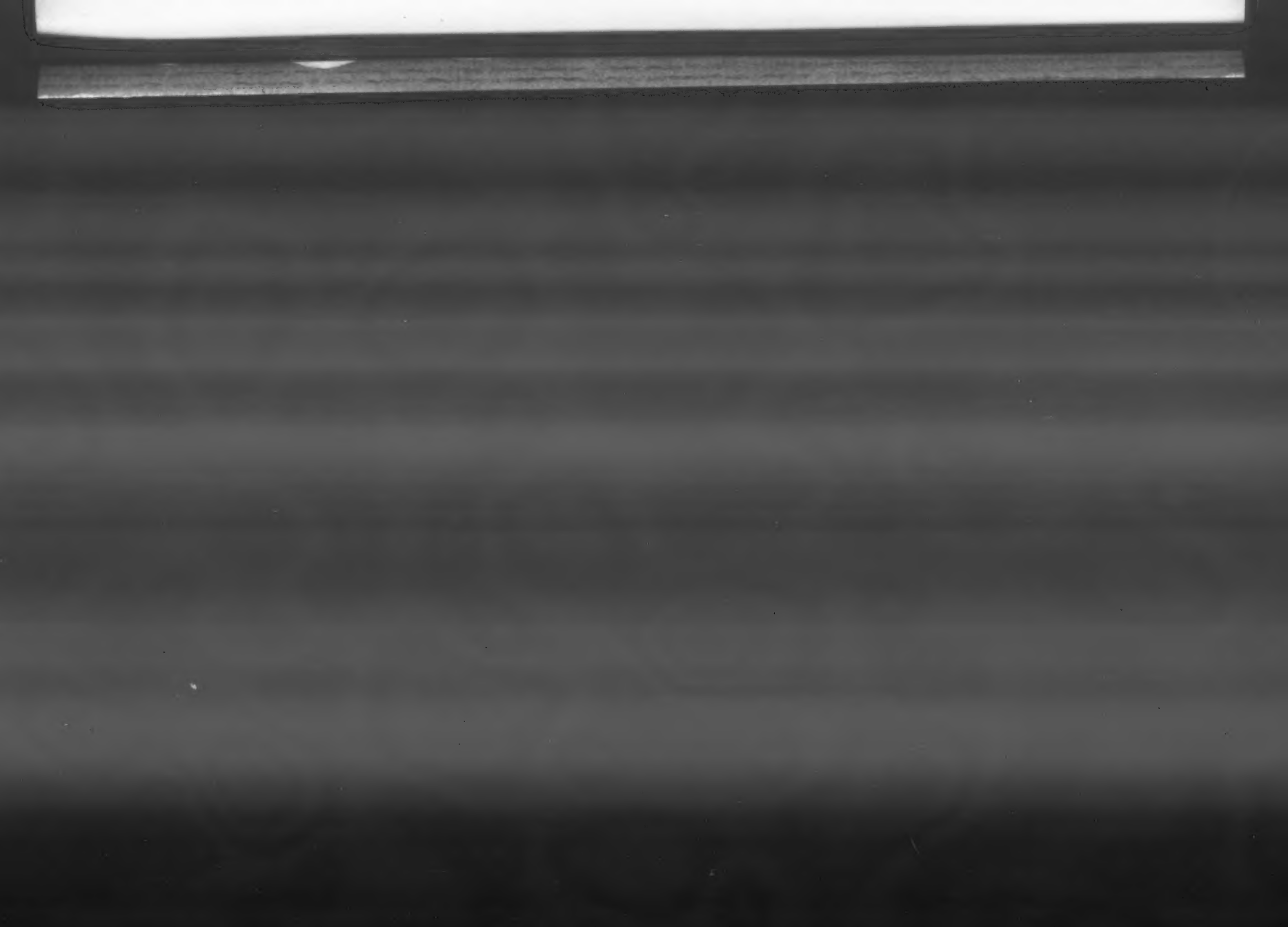




MUNICIPAL ENGINEERING

VOLUME XXX. APRIL, NINETEEN HUNDRED SIX. NUMBER FOUR

CONCRETE BUILDING BLOCKS.*

By S. B. Newberry, Sandusky, Ohio.

In the industrial progress of this country there is no feature more remarkable and striking than the development which has taken place in the applications of Portland cement. Fifteen years ago the amount of Portland cement used for all purposes in the United States was about 2,500,000 barrels, of which four-fifths was imported from Europe. In 1905 the consumption exceeded 30,000,000 barrels, a twelve-fold increase, and practically the whole of this is of American manufacture. The first and greatest victory won by the new material was its substitution for block stone in masonry constructions, such as piers, abutments and foundations, and for flag-stone in the laying of sidewalks. Then followed a multitude of lesser uses, such as sewer-pipe, tiles, fence-posts, curb and gutter, piles, and ornamental architectural work of every description. Reinforced concrete has come rapidly into use in the construction of complete buildings and bridges.

Having gained full recognition as a building material of the first rank in engineering and monumental architecture, Portland cement is now invading the field of dwelling construction. All but the more costly dwellings have, until recently, been built of wood, a material that has only the qualities of cheapness and convenience to recommend it, since frame structures are admittedly perishable, uncomfortable, and unsafe against fire. Lately, however, wood has lost even the quality of cheapness, and owing to the exhaustion of our forests, has advanced fully 50 per cent. in price. This has been a great hardship to home-seekers, and has forced builders to look for some other material for dwelling construction. Happily, Portland cement comes to the front, as usual, to fill the want. The hollow concrete building block, properly made and used, forms an ideal material for the exterior walls of buildings, and this replaces the part which, in wood, most rapidly deteriorates from exposure to weather. Buildings constructed of hollow concrete blocks are no higher in first cost than those built of frame, and are far less expensive in repairs. They have all the advantages of stone and brick in point of comfort, coolness in summer and warmth in winter, and in respect of beauty may at small cost be made fully equal to those of any other material.

Unfortunately, owing to poor workmanship and lack of artistic design, a large part of the hollow block buildings hitherto erected have fallen far short of the excellence above described. A multitude of men without capital and inexperienced in the use of cement have embarked in the business of block making, attracted by the glowing prospects of profits held out by the army of block machine agents. As a result, great quantities of inferior blocks, weak, porous and unsound, have been and are being turned out, and have been erected by careless and unskilled builders into defective and ugly structures. This state of affairs is an injury to competent and conscientious block manufacturers, and an obstacle to the adoption of a most excellent and promising building material. Blocks of first-rate quality can easily and cheaply be made, with small outlay for machinery, provided certain simple rules are intelligently followed. It is the purpose of this paper to state briefly the causes of faults in concrete blocks, and the precautions by which good and reliable work may be assured.

Concrete.—Concrete is an artificial stone consisting of coarse and fine fragments, such as sand, gravel and broken stone, united by cement to a solid mass.

The strength of concrete depends greatly upon its density, and this is secured by using coarse material which contains the smallest amount of voids or empty spaces.

*From a paper before the National Association of Cement Users.

Different kinds of sand, gravel and stone vary greatly in the amount of voids they contain, and by judiciously mixing coarse and fine material the voids may be much reduced and the density increased. The density and percentage of voids in concrete material may be determined by filling a box of one cubic foot capacity and weighing it. One cubic foot of solid quartz or limestone, entirely free from voids, would weigh 165 pounds, and the amount by which a cubic foot of any loose material falls short of this weight represents the proportion of voids contained in it. For example, if a cubic foot of sand weighs 115½ pounds, the voids would be 49½ 165ths of the total volume, or 30 per cent.

The following table gives the per cent. of voids and weight per cubic foot of some common concrete materials:

	Per Cent Voids.	Wt. per cu ft.
Sandusky Bay sand.....	32.3	111.7 lbs.
Same through 20-mesh screen	38.5	101.5 lbs.
Gravel, ¼ to ⅛ inch.....	42.4	95.0 lbs.
Broken limestone, egg-size	47.0	87.4 lbs.
Limestone screenings, dust to ½ inch.....	26.0	122.2 lbs.

It will be noted that screening the sand through a 20-mesh sieve, and thus taking out the coarse grains, considerably increased the voids and reduced the weight; thus decidedly injuring the sand for making concrete.

The following figures show how weight can be increased and voids reduced by mixing fine and coarse material:

	Per Cent Voids	Wt. per cu ft.
Pebbles, about 1 inch....	38.7	101.2 lbs.
Sand, 30 to 40 mesh.....	35.9	105.8 lbs.
Pebbles, plus 38.7 per cent. sand, by vol.....	19.2	133.5 lbs.

Experiments have shown that the strength of concrete increases greatly with its density; in fact, a slight increase in weight per cubic foot adds very decidedly to the strength.

The gain in strength obtained by adding coarse material to mixtures of cement and sand is shown in the following table of results of experiments made in Germany by R. Dykerhoff. The blocks tested were 2½-inch cubes, 1 day in air and 27 days in water:

Proportions by measure.			Per cent. cement by volume.	Comp. strength lbs. per sq. in.
Cement.	Sand.	Gravel.		
1	2	...	33	2,125
1	2	5	12.5	2,387
1	3	...	25	1,383
1	3	6½	9.5	1,515
1	4	...	20	1,053
1	4	8½	7.4	1,204

These figures show how greatly the strength is improved by adding coarse material, even though the proportion of cement is thereby reduced. A mixture of 1 to 12½ of properly proportioned sand and gravel is, in fact, stronger than 1 to 4, and nearly as strong as 1 to 3, of cement and sand only.

In selecting materials for concrete, those should be chosen which give the the greatest density. If it is practicable to mix two materials, as sand and gravel, the proportion which gives the greatest density should be determined by experiment, and rigidly adhered to in making concrete, whatever proportion of cement it is decided to use. Well proportioned dry sand and gravel or sand and broken stone, well shaken down, should weigh at least 125 pounds per cubic foot. Limestone screenings, owing to minute pores in the stone itself, are somewhat lighter, though giving equally strong concrete. If the weight is less, there is probably too much fine dust in the mixture.

The density and strength of concrete are also greatly improved by use of a liberal amount of water. Enough water must be used to make the concrete thoroughly soft and plastic, so as to quake strongly when rammed. If mixed too dry, it will never harden properly, and will be light, porous and crumbling.

Thorough mixing of concrete materials is essential, to increase the density and give the cement used a chance to produce its full strength. The cement, sand and gravel should be intimately mixed, dry, then the water added and the mixing continued. If stone or coarse gravel is added, this should be well wetted and thoroughly mixed with the mortar.

Materials for Concrete Building Blocks.—In the making of building blocks the spaces to be filled with concrete are generally too narrow to permit the use of very coarse material, and the block-maker is limited to gravel or stone not exceeding ½ or ¾ inch in size. A considerable proportion of coarse material is, however, just as necessary as in other kinds of concrete work, and gravel or screenings should be chosen which will give the greatest possible density. For good results, at least one-third of the material, by weight, should be coarser than ⅛ inch. Blocks made from such gravel or screenings, 1 to 5, will be found as good as 1 to 3 with sand only. It is a mistake to suppose that the coarse fragments will show on the surface; if the mixing is thorough, this will not be the case. A moderate degree of roughness or variety in the surface of blocks, is, in fact, desirable, and would go far to overcome the prejudice which many architects hold against the smooth, lifeless surface of cement work.

Sand and gravel are, in most cases, the cheapest material to use for block work. The presence of a few per cent. of clay or loam is not harmful, provided the mixing is thorough.

Stone screenings, if of good quality, give fully as strong concrete as sand and gravel, and usually yield blocks of somewhat lighter color. Screenings from soft stone should be avoided, also such as contain too much dust. This can be determined from the weight per cubic foot, and by a sifting test. If more than two-thirds pass ⅛ inch, and the weight (well jarred down) is less than 120 pounds, the material is not the best.

Cinders are sometimes used for block work; they vary greatly in quality, but if clean and of medium coarseness, will give fair results. Cinder concrete never develops great strength, owing to the porous character and crushability of the cinders themselves. Cinder blocks may, however, be strong enough for many purposes, and suitable for work in which great strength is not required.

Lime.—It is well known that slaked lime is a valuable addition to cement mortar, especially for use in air. In sand mixtures, 1 to 4 or 1 to 5, at least one-third of the cement may be replaced by slaked lime without loss of strength. The most convenient form of lime for use in block-making is the dry-slaked or hydrated lime, now a common article of commerce. This is, however, about as expensive as Portland cement, and there is no great saving in its use. Added to block concrete, in the proportion of ¼ to ½ the cement used, it will be found to make the blocks lighter in color, denser, and decidedly less permeable by water.

Cement.—Portland cement to-day is the only hydraulic material to be seriously considered by the block-maker, and at present prices there is nothing gained by attempting the use of any of the cheaper substitutes. Natural and slag cements and hydraulic lime are useful for work which remains constantly wet, but greatly inferior in strength and durability when exposed to dry air. A further advantage of Portland cement is the promptness with which it hardens and develops its full strength; this quality alone is sufficient to put all other cements out of consideration for block work.

Proportions.—There are three important considerations which must be kept in view in adjusting the proportions of materials for block concrete—strength, permeability, and cost.

So far as strength goes, it may easily be shown that concretes very poor in cement, as 1 to 8 or 1 to 10, will have a crushing resistance far beyond any load that they may be called upon to sustain. Such concretes are, however, extremely porous and absorb water like a sponge. It is necessary, also, that the blocks shall bear a certain amount of rough handling at the factory and while being carted to work and set up in the wall, and safety in this respect calls for a much greater degree of hardness than would be needed to bear the weight of the building. Again, strength and hardness, with a given proportion of cement, depend greatly on the character of the other materials used; blocks made of cement and sand, 1 to 3, will not be so strong or so impermeable to water as those made from a good mixed sand and gravel, 1 to 5. On the whole, it is doubtful whether blocks of satisfactory quality can be made, by hand mixing and tamping, under ordinary factory conditions, from a poorer mixture than 1 to 5. Even this proportion requires for good results the use of properly graded sand and gravel or screenings, a liberal amount of water, and thorough mixing and tamping. When suitable gravel is not obtainable, and coarse mixed sand only is used, the proportion should be not less than 1 to 4. Fine sand alone is a very bad material, and good blocks can not be made from it except by the use of an amount of cement which would make the cost very high.

The mixtures above recommended, 1 to 4 and 1 to 5, will necessarily be somewhat porous, and may be decidedly so if the gravel or screenings used is not properly graded. The water-resisting qualities may be greatly improved, without loss of strength, by replacing a part of the cement in filling the pores of the concrete. It has also the effect of making the wet mixture more plastic and more easily compacted, and gives the finished blocks a lighter color.

The following mixtures, then, are to be recommended for concrete blocks. By gravel is meant a suitable mixture of sand and gravel, or some screenings, containing grains of all sizes, from fine to ½-inch:

1 to 4 Mixtures, by Weight.

Cement 150, gravel 600.
Cement 125, hyd. lime 25, gravel 600.
Cement 100, hyd. lime 50, gravel 600.

1 to 5 Mixtures, by Weight.

Cement 120, gravel 600.
Cement 100, hyd. lime 20, gravel 600.

Proportions of Water.—This is a matter of the utmost consequence, and has more effect on the quality of the work than is generally supposed. Blocks made from too dry concrete will always remain soft and weak, no matter how thoroughly sprinkled afterwards. On the other hand,

if blocks are to be removed from the machine as soon as made, too much water will cause them to stick to the plates and sag out of place. It is perfectly possible, however, to give the concrete enough water for maximum density and first-class hardening properties, and still to remove the blocks at once from the mould. A good proportion of coarse material allows the mixture to be made wetter without sticking or sagging. Use of plenty of water vastly improves the strength, hardness and waterproof qualities of blocks, and makes them decidedly lighter in color. The rule should be:

Use as much water as possible without causing the blocks to stick or to sag out of shape on removing from the machine.

The amount of water required to produce this result varies with the materials used, but it is generally from 8 to 9 per cent. of the weight of the dry mixture. A practical block-maker can judge closely when the right amount of water has been added, by squeezing some of the mixture in the hand. Very slight variations in proportion of water make such a marked difference in the quality and color of the blocks that the water, when the proper quantity for the materials used has been determined, should always be accurately measured out for each batch. In this way much time is saved and uncertainty avoided.

Facing.—Some block-makers put on a facing of richer and finer mixture, making the body of the block of poorer and coarser material. As will be explained later, the advantage of the practice is, in most cases, questionable, but facings may serve a good purpose in case a colored or specially waterproof surface is required. Facings are generally made of cement and sand or fine screenings, passing a ⅛-inch sieve. To get the same hardness and strength as a 1 to 5 gravel mixture, at least as rich a facing as 1 to 3 will be found necessary. Probably 1 to 2 will be found better, and if one-third the cement be replaced by hydrated lime, the waterproof qualities and appearance of the blocks will be improved. A richer facing than 1 to 2 is liable to show greater shrinkage than the body of the block, and to adhere imperfectly or develop hair-cracks in consequence.

Poured Work.—The above suggestions on the question of proportions of cement, sand and gravel for tamped blocks apply equally to concrete made very wet, poured into the mould, and allowed to harden a day or longer before removing. Castings in a sand mould are made by the use of very liquid concrete; sand and gravel settle out too rapidly from such thin mixtures, and rather fine limestone screenings are generally used.

Mixing.—To get the full benefit of the cement used it is necessary that all the materials shall be thoroughly mixed together. The strength of the block as a whole will be only as great as that of its weakest part, and it is the height of folly, after putting in a liberal measure of cement, to so slight the mixing as to get no better result than half as much cement, properly mixed, would have given. The poor, shoddy and crumbly blocks turned out by many small-scale makers owe their faults chiefly to careless mixing and use of too little water, rather than to too small proportion of cement.

The materials should be mixed, dry, until the cement is uniformly distributed and perfectly mingled with the sand and gravel or screenings; then the water is to be added and the mixing continued until all parts of the mass are equally moist and every particle is coated with the cement paste.

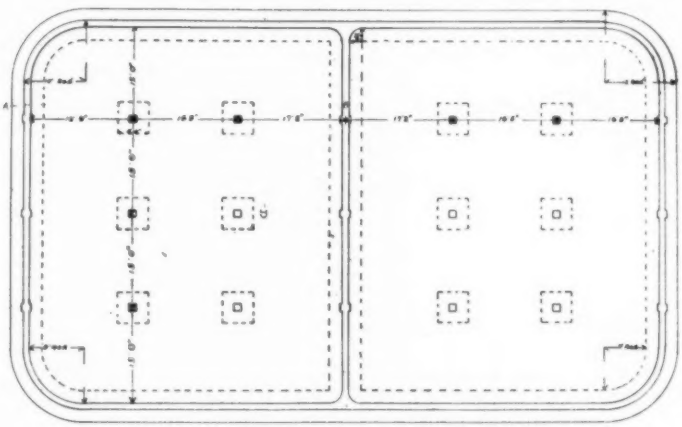
Concrete Mixers.—Hand-mixing is always imperfect, laborious and slow, and it is impossible by this method to secure the thorough stirring and kneading action which a good mixing machine gives. If a machine taking 5 or 10 horsepower requires five minutes to mix one-third of a yard of concrete, it is, of course, absurd to expect that two men will do the same work by hand in the same time. And the machine never gets tired or shirks if not constantly urged, as is the nature of men to do. It is hard to see how the manufacture of concrete blocks can be successfully carried on without a concrete mixer. Even for a small business it will pay well in economy of labor and excellence of work to install such a machine, which may be driven by a small electric motor or gasoline engine. In work necessarily so exact as this, requiring perfectly uniform mixtures and use of a constant percentage of water, batch mixers, which take a measured quantity of material, mix it, and discharge it, at each operation, are the only satisfactory type, and continuous mixers are unsuitable. Those of the pug-mill type, consisting of an open trough with revolving paddles and bottom discharge, are positive and thorough in their action, and permit the whole operation to be watched and controlled. They should be provided with extensible arms of chilled iron, which can be lengthened as the ends become worn.

RESERVOIR AT FT. MEADE, S. D.

By S. H. Rea, Sturgis, S. D.

While the use of reinforced concrete in reservoir construction is in no sense a novelty, especially for structures of moderate size, this method of construction is receiving favorable consideration from engineers in designing good-sized structures, and it is thought that a description of a recently completed reservoir will be of timely interest.

The reservoir under consideration was built in connection with the new water supply system of Fort Meade, and army post situated near the town of Sturgis, South Dakota. It has a capacity of 500,000 gallons, contained in two compartments of equal size. The accompanying ground plan shows the dimensions, outlines of wall and column footings and arrangement of compartments. It will be seen that each compartment is 50 by 60 feet, inside dimensions, with rounded corners. The details of reinforcement and the arrangement of connecting pipes are shown on separate plans; the photographs show the appearance of the structure under construction and completed.



PLAN OF RESERVOIR AT FT. MEADE, S. D.

The reservoir is located upon a hilltop at an elevation about 200 feet above the general elevation of Fort Meade. It is built partly below the surface, about 8 feet, or nearly half its height, being above the ground level. The excavation was made in coarse gravel of a compact nature, teams and scrapers being used to handle the material. The bottom of the pit after completion of excavation was compacted with a heavy roller, after which the excavations below bottom of floor for wall and column footings were carefully made by hand.

The first concrete work done was in the wall footings; the metal reinforcement was carefully placed in position and embedded in the concrete as the work progressed. Directly under the wall space a trough or depression, about 6 inches deep and 18 inches wide, was left in the upper surface of footing for its entire length, to receive the new concrete when building the wall. This arrangement insured a good bond between wall and footing, making for watertightness at a place where the water pressure against the walls would be the greatest. Concrete work was continued from footings out over floor space, the entire area between inclosing walls being covered as rapidly as possible. Each compartment of the reservoir was treated practically as a unit and the concrete work therein was made as nearly monolithic as practicable. The concrete in the floor was brought up to a suitable height and the lower reinforcing bars were then placed in position. The bars in the upper layer were then placed in their proper position at right angles to the lower bars, and the two sets were wired together to prevent displacement, thus forming a gridiron around and over which the remaining concrete was placed.

In building the walls the upright bars were first secured in position, being held at the proper distance apart by horizontal wooden strips with holes bored at suitable intervals to receive the bars. The horizontal bars in the walls were wired in

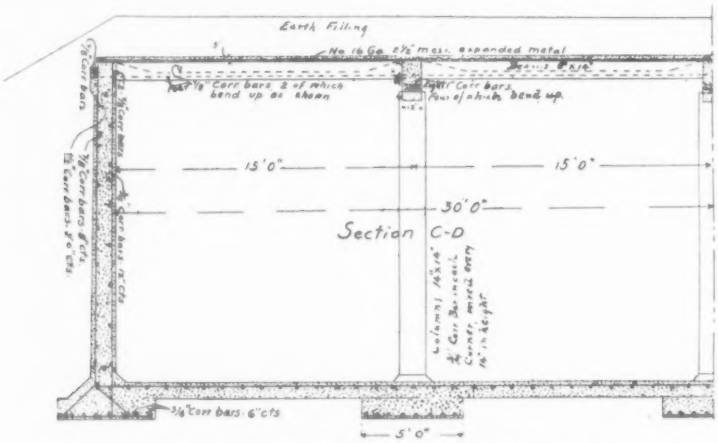
place to the vertical bars at proper intervals; they were placed in position ahead of the concreting as the wall was built up. At places where concrete work in the wall was temporarily discontinued a stop board was used to square up the end of the concrete and to make a vertical joint. A piece of 4 by 4 inch lumber was attached to the face of stop board that was placed next to the concrete. This caused a vertical mortise in the concrete, the effect of which was to make a tight joint with the new concrete.

The reinforcement used in footings, floor, walls, girders and columns consisted of corrugated steel bars of the dimensions shown on plan. The roof slab was reinforced by No. 16 gauge, 2½-inch mesh expanded metal. The reinforcement for the entire structure was furnished by the St. Louis Expanded Metal Fireproofing Company, of St. Louis, Mo. The same company furnished the design for the system of reinforcement. The general plan for the reservoir was prepared in the office of the Quartermaster General, U. S. Army.

The forms for walls were sheathed with 2-inch plank, surfaced on inner face and placed horizontally on edge. They were held in place by 4 by 4 inch vertical posts, spaced about 4 feet apart in pairs, one on either side of wall. These posts were firmly braced at bottom and top; they were prevented from spreading by wires passing through the wall space from post to post and tightly strained. At the rounded outer corners of the reservoir the pairs of posts were spaced about 2 feet apart and the curve was made by springing this plank into place to fit the curve and nailing them to the posts. The posts were high enough to reach the top of wall; the sheathing was built up one plank at a time as concreting progressed.

In building the columns the four vertical reinforcing bars, one at each corner, were first secured in place, the lower ends of bars being embedded in the concrete of floor and the upper ends held in place by braces extending to adjacent columns and walls. The column forms were made of 2-inch planks extending from floor to girder, with three sides inclosed and one side left open to receive concrete. This side was closed up as the concreting advanced in height.

The girder forms consisted of tight wooden troughs, open at the top; they were made of 2-inch planks, with inner faces smooth.

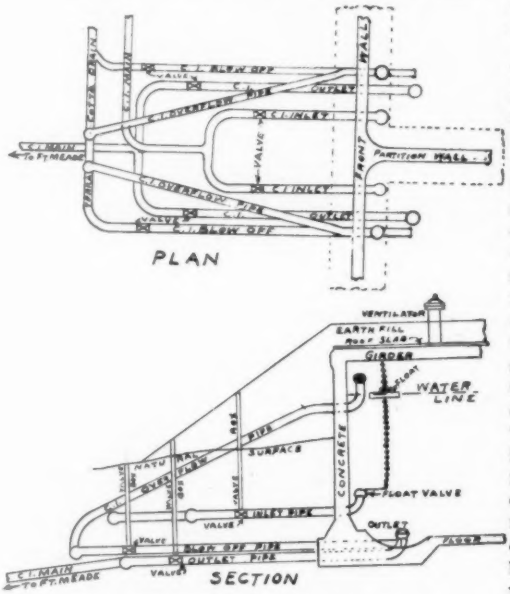


CROSS SECTION OF RESERVOIR AT FT. MEADE S. D.

These forms were connected at their ends with wall and column forms; at their sides they joined the roof centering. The beam forms were at right angles to girder forms; they were connected at their ends to girder forms and at their sides to roof centering. The form or centering for the roof slab consisted of a smooth, tight floor of 2-inch planks extending between the open tops of column, beam and girder forms, over the entire area between inclosing walls of reservoir. The roof centering and also the beam and girder forms were supported upon 6x6-inch posts resting upon the floor below. The corrugated bars in beam and girder forms were placed in position and held up by blocks, which were removed as the forms were filled up with concrete. The expanded metal reinforcement for roof slab was placed so as to be close to the lower

face of slab, but at the same time far enough up to be entirely inclosed by the concrete.

The concrete was composed of one part by measure of Portland cement, two parts sand, and four parts crushed stone. Measurement of sand and stone was made in iron wheelbarrows of 2½ cubic feet capacity. The cement was delivered in ¼-barrel sacks; each sack was taken as one cubic foot. The cement was an American Portland of good quality, which showed up well in preliminary tests and which gave satisfactory results in use. The sand was fairly clean and sharp, but it contained a considerable percentage of fine grains. It was, however, the best sand



RESERVOIR AT FT. MEADE, S. D.
Plan and Section of Inlet and Outlet Pipes.

available for use and, while it was not all that could be desired, the results obtained were good. The crushed stone was of excellent quality, hard and angular, with sharp edges and angles. The supply of rock for crushing was obtained from field stone found on the surface of the ground in the vicinity of the reservoir site. This stone was loaded into wagons by hand and hauled to the crusher, which was installed adjacent to the work. The individual stones ranged in size from that of an egg to that requiring two men to handle. They were rounded in form and of several varieties, including granite, limestone, quartz and a very hard species of sandstone. A considerable amount of soft sandstone was found; this was rejected as being unfit for use. The stone was crushed to a size not larger than a ¾-inch cube. The entire product of the crusher was used, no screenings being permitted; the object was to obtain aggregates that would form concrete of maximum density.

The concrete was mixed by hand upon a mixing platform, which was moved from place to place as required. Four men were employed in mixing and placing the concrete. These men handled all the concrete material from supply pile to mixing platform; after mixing a batch they deposited the concrete in the forms. The concrete was mixed in batches of the following sizes and proportions:

2½ sacks Portland cement....	2½ cub. ft.
2 wheelbarrows sand.....	5 cub. ft.
4 wheelbarrows crushed stone.	10 cub. ft.

The method of mixing was as follows: The stated quantity of sand was spread upon the platform in a layer three or four inches thick. The cement was then spread evenly over the sand and the mass was mixed dry by turning with shovels until it was of a uniform color; it was then spread out upon the platform. The crushed stone, having first been wetted, was distributed evenly over the mixed sand and cement and the entire mass was turned over and over with shovels. Water was added in sufficient quantity to make the resulting concrete of the required consistency, the whole being turned until thoroughly mixed. The mixture was made quite wet, the object being to form a "slush" concrete which would flow readily and fill all angles and corners in the forms and leave no voids in the interior of the mass or around the metal reinforcement. Naturally, in a soft mass of this character ramming or pounding would not be effective. The concrete was tamped with a handle of ¾-inch round iron and having at the lower end a flat blade about 4 inches wide. One man was employed in tamping the concrete, using this tool to joggle the wet mass into place around the metal bars and also to spade it along outer face of wall next to form to allow fine material to flow in and form a smooth surface. Only the outside wall faces were spaded in this manner, the inner faces being left preferably rough to receive the plaster finishing coat.

No great speed was attained in performing the concrete work, the rate being dependent upon the progress made in erecting the forms. The supply of carpenters available for form building was limited, due partly to the remote location and partly to the demand for skilled labor in the new building construction being done at the time at Fort Meade. The cost of forms per cubic yard of concrete was comparatively high, this being due

to the thinness of the walls, for which a relatively greater amount of lumber and labor was required than for more massive construction of ordinary concrete.

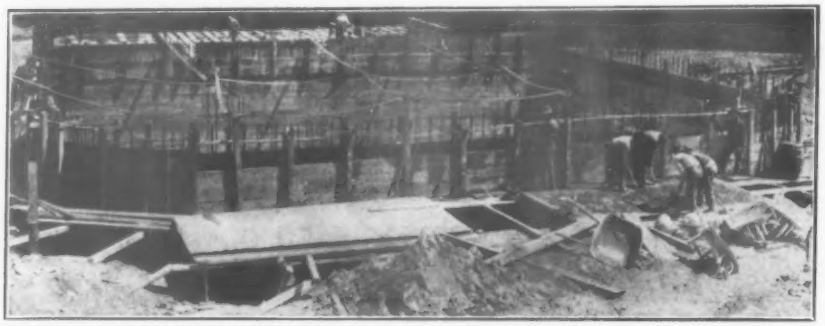
On account of the thinness of the walls it was of great importance that the concrete should be dense and compact to insure watertightness. In order to secure a finished wall sufficiently tight to be fairly impervious, it was evident at the outset that the following requirements were necessary:

1. The aggregates in the concrete should be so proportioned that all voids would be filled.

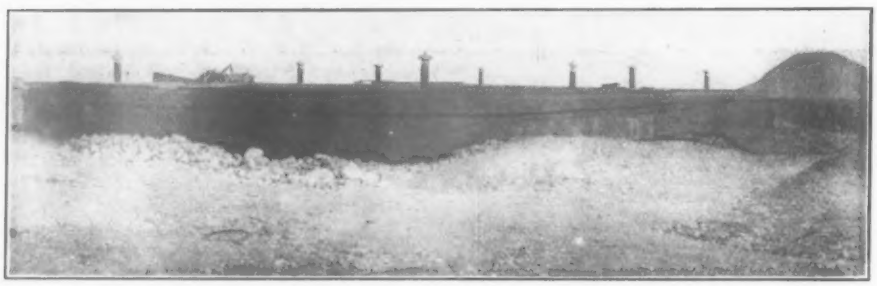
2. The concrete mixture should be homogeneous and compact, with no air pockets or unfilled spaces in the interior.

3. The surface coating should be sufficiently rich to insure watertightness; it should be properly applied to secure adhesion to the wall surface.

The first requirement was met by crushing the stone to ¾-inch size and by using run of crusher in the concrete. From careful tests it was found that the voids in this material did not exceed 32 per cent. The sand was found to contain about 30 per cent. of voids. It is evident, therefore that a 1-2-4 mixture of such materials will produce a dense concrete, one with all voids filled and having considerable excess of mortar. The second requirement was met by making a wet mixture, having it thoroughly mixed and well spaded after placing in the forms. The third requirement calls for an impervious wall coating. The proportions required for the mortar were 1 cement to 1 sand. This made a rich mortar, the only objection to which was its supposed liability to crack upon drying out. The plaster was applied to the inner surface of walls in coats about one-fourth of an inch thick to a thickness of three-fourths of an inch. Little trouble was experienced from cracks; the few that appeared were filled with grout applied with a brush. The floor surface, 1 inch thick, was composed of the same mortar. It was laid in strips about 3 feet wide, leaving spaces between strips of same width. As soon as these strips had set the alternate spaces were filled in with mortar, the entire surface of floor being troweled smooth.



RESERVOIR AT FT. MEADE, S. D.
Forms in Place. Mixing and Placing Concrete.



RESERVOIR AT FT. MEADE, S. D.
Completed but not yet Covered.

The outside surface of walls and roof was covered with a coat of tar applied hot. A portable heater was used, being moved from place to place and keeping the tar heated to a temperature of about 360 degrees Fahrenheit. The hot tar was applied with a stiff brush; it was well rubbed into every corner, the object being to leave no bare spots.

The details of pipe connections are shown in the accompanying drawing. The water supply is led through an 8-inch cast-iron main to within 14 feet of front wall, where a tee connects it with two inlet pipes, one leading into each compartment of the reservoir. The inner end of each inlet pipe is provided with a cut-off valve operated by a float, which works automatically, cutting off the flow of the water when the compartment is filled to the required height. An overflow pipe is provided to carry off the surplus water in case the float valve should fail to work. The upper end of overflow pipe is provided with a globe wire strainer. Two outlet pipes, one for each compartment, are connected at a point 20 feet from reservoir, with the cast-iron main running to Fort Meade. These have wire strainers on upper ends to prevent leaves, chips and trash from entering main. A blow-off pipe is provided for each compartment, opening to a depression in the floor. The blow-off and overflow pipes connect into a terra cotta drain pipe, which discharges upon the hillside. All pipes, except drain pipe, are of cast iron, 8 inches in diameter. The drain pipe is of terra cotta and is 10 inches in diameter. The several lines of pipe are provided with gate valves as shown.

The entire structure after completion was covered with earth to a depth of 2 feet over top, sloping off on all sides to the natural surface of ground. The earth was moved by means of teams and scrapers, and in placing it a good opportunity was afforded to test the strength and rigidity of the roof slab. As this was only 3 inches thick, some apprehension had been manifested during construction regarding its strength. When the earth fill was being placed the roof was tested by driving four scraper teams upon it at once. No vibrations or signs of weakness were noticeable.

RESERVOIR AT FT. MEADE, S. D.

Corner of Completed Reservoir Showing Concrete Walls, Columns, Roof Beams, Roof, Manway Steps, Valve and Float.

Eight 10-inch ventilators, four for each compartment, were inserted in the roof to afford ventilation. Access to the interior of reservoir is had by means of two circular manways, 2 feet in diameter, one for each compartment, at junction of front and partition walls. A flight of ¾-inch round stepping irons, built into wall, leads from each manway to floor of reservoir. The walls of manway above roof are of concrete, 6 inches thick; they extend to top of earth fill. The top is covered by a trap door made of No. 10 boiler plate and set in a cast-iron frame bedded in concrete.

The reservoir was tested by filling both

compartments with water and allowing this to stand 36 hours. An open space was left in earth fill along front wall around the water pipes for the purpose of observing signs of leakage. This space was closely examined and the only sign of leakage found was a damp patch on outer face of wall near inlet pipe. Continued exposure did not show any exudation of water or any increase in size of patch. The water level inside of reservoir remained unchanged, showing no loss of water from leakage. One compartment was then drained, leaving other compartment full, and the empty compartment was entered and examined, no signs of weakness being noted. The empty compartment was then refilled and the full compartment emptied and examined, with the same result. The reservoir was then considered satisfactory and was accepted for use.

CONDUITS FOR ELECTRIC WIRES IN HARTFORD, CONN.

The City Engineer of Hartford, Conn., Mr. Frederick L. Ford, has recently made a report upon an underground wiring system for the city which gives evidence of a very thorough study of the problem. The following is derived from his report to the Board of Street Commissioners:

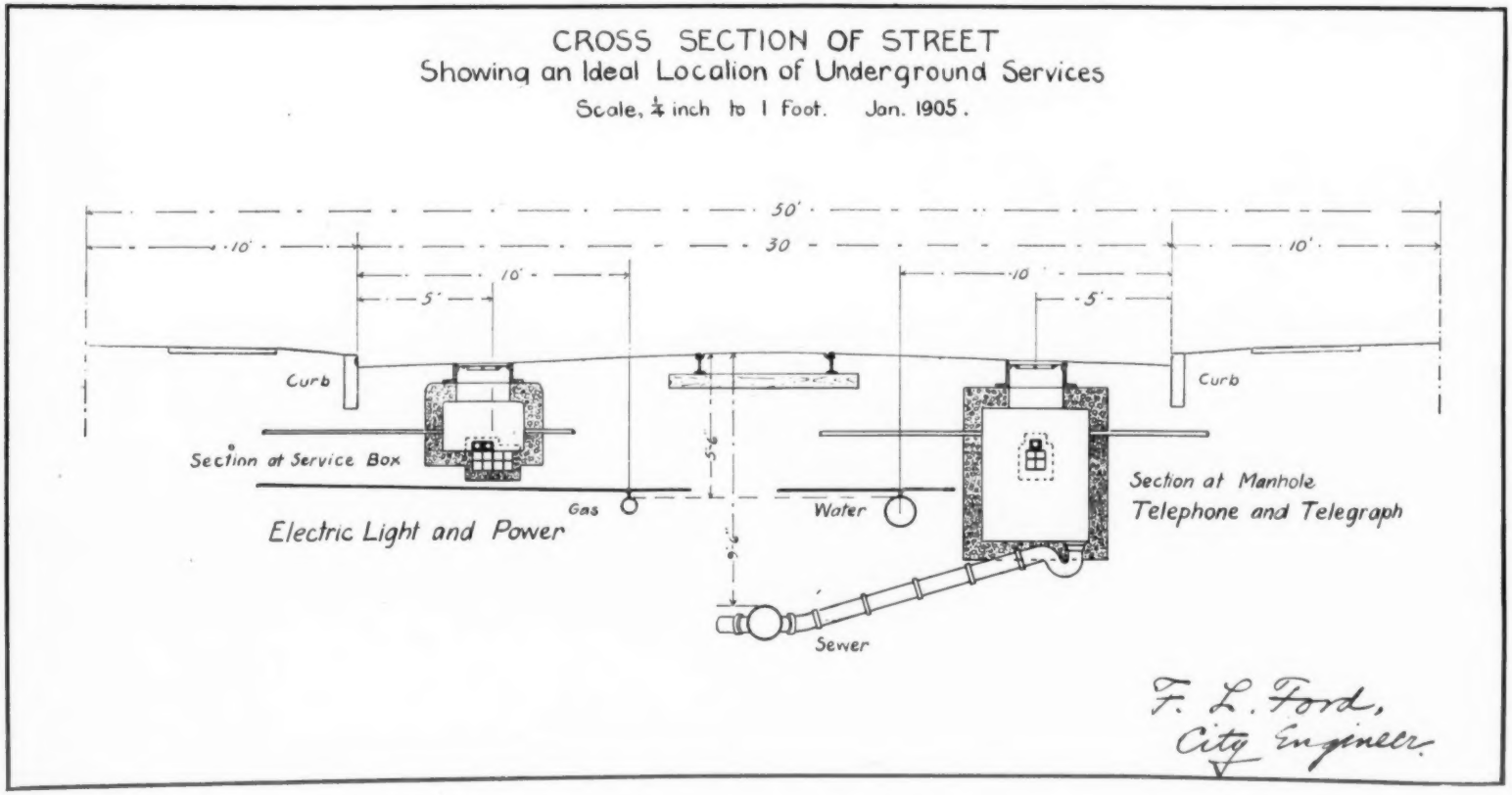
The charter of the city was amended in 1895 to permit the city officials to require the placing of electric wires under ground and limiting the work to the square mile about the City Hall as a center for the first ten years. An ordinance was passed in 1896 authorizing the work in the southern half of the mile. Nine companies were affected by the ordinance and all have complied with its provisions except the Hartford Street Railway Company, each making its construction according to its own system, although the feed wires of the street railway were definitely mentioned in the report. Several of the companies have extended their work outside the first limits. The city now has power under the charter provision to extend the work as far as it deems necessary.

Mr. Ford, in his report upon future work, thinks that the city should name the objectionable lines of wire which should go underground, and that the choice should be made first as to danger to life and property, three high-tension wires, for example, being ordered underground where three telegraph wires would be permitted to remain; second, as to appearance, some districts of fine appearance, narrow streets, etc., requiring removal, while less attractive streets and those of considerable width would warrant keeping the pole lines; third, as to revenue from lines, the well-loaded lines being better able to pay the expense of the change than those with but few taps.

The report argues that the underground conduits should oe constructed by the city, citing the recommendations of commissions and the practice in Baltimore, Rochester, Utica, Wheeling, W. Va.; New Castle and Erie, Pa.; New Britain and Bristol, Conn., etc. The city thus retains absolute control, can lay the ducts in the most serviceable manner for all concerned, including the city, controls the street repairs, makes entry of new companies easy and prevents the duplication of conduit lines which is practically necessary under private ownership, notwithstanding provisions requiring rental of space to other companies. His only argument against municipal ownership is the bonding of the city for the cost. He proposes a rental per duct which will pay the maintenance charges, interest and sinking fund, repaying the primary expenditures within twenty-five years. If the companies are permitted to do their own work he recommends most thorough supervision of design and construction. The figures and designs in the report are made of estimates of the probable needs of the city for twenty-five years.

The report recommends vitrified, salt-glazed clay ducts, surrounded by Portland cement concrete, ventilated ducts and manholes by pipes run up beside pole at the curb line, with short down-draft pipes near by. High and low-tension wires can be placed in ducts a foot apart, but for safety and convenience there should be two sets of manholes. Induction is taken care of by transposing or twisting wires in cables. All ducts should therefore be laid in the same trench. The ideal section of the usual 50-foot Hartford street would show a 30-foot roadway with sewer in the center, water and gas mains each 10 feet from curb and conduits 5 feet from curb, giving ample room for usual manholes, 7 1-3x6 1-3 feet outside. It is shown in the accompanying drawing.

The various methods of distribution of wires to services are described. It is stated that the system most generally installed when conduits are constructed uses overhead pole lines along the street curb, or through alleys in cities having them, the former requiring pole lines



SUBWAY CONSTRUCTION PLANS AT HARTFORD, CONN.

along two and sometimes four sides of a block. Where there are no alleys the poles may be set in back yards. Other systems use a single pole to distribute wires from a cable from the conduit, as many poles being used as the demands of the service require; a pole in the center of a small block with wires radiating to the various houses; single overhead terminals on rear walls of buildings; in business districts ducts and groups of wires run through the cellars of the buildings. The disadvantages of each of these systems are shown in the report. The best system is described as serving each property with a distribution duct, or from a duct laid between two properties. All overhead wires are thus eliminated, but the service is expensive, since there must be conduits on from two to four sides of the block and the distribution ducts increase the cost per foot of conduit. Telephone companies have some trouble with party lines in this system.

The estimate of cost of conduits on macadamized streets is $16,000 a mile, and 82 miles of street additional to the eight miles now served would require over $1,300,000, in addition to the extra cost of the underground cables. The present wire damages do not justify this expenditure. If the 125 miles of arc street lighting wire are put underground the cost of 70 miles of one- to five-duct conduits, manholes and junction boxes would be $290,000 and of cables $65,000. Interest, maintenance, depreciation and sinking fund at 10 per cent. would increase the cost of the 810 arc lamps about $42 a year, which would be added to the present price of $70. The cost of putting all the electric-light company's wires underground would be about $700,000, or $10,000 per mile of conduit. At this rate a mile or two a year of the lines in worst condition could reasonably be required.

The conclusions regarding the work that should be done in Hartford are as follows:

First, before any attempt is made to duct the overhead wires of the various corporations outside of the limits prescribed in the legislative enactment of June 22, 1895, the Hartford Street Railway Company should be compelled to follow the course pursued by the other corporations during the past ten years and duct all of their feed wires within the half-mile limit from the City Hall. If there is available capacity these feeders should be placed within the conduits of the Hartford Electric Light Company, otherwise within their own conduits.

Secondly, the city of Hartford should at once stop the issuance of permits for the duplication of unsightly pole lines upon our city streets. The photographs accompanying this report furnish conclusive evidence that miles of telephone wires are run within our city limits upon the same poles with 200-volt service wires, 2,400-volt feeders and arc circuits, and 10,000-volt transmission lines, all with alternating current, without interfering with the commercial use of any telephone. I should hesitate to say that only one line of poles would be necessary on streets where there are street-railway tracks, on account of the difficulty of using the iron trolley poles for the service which might be required by the different companies; but upon streets where there are no street railway tracks there is no necessity for more than a single line of poles. I believe that the different companies have in the past insisted upon duplicate lines principally for their own convenience and independence.

Thirdly, the city of Hartford should continue its policy of the past ten years by a gradual extension of its conduit system, for there is no better evidence of the civic progressiveness of a municipality than by the removal of its dangerous and unsightly overhead wires, as fast as possible.

The city should order underground construction when the local conditions require it; should endeavor to have the different corporations build large enough for the requirements twenty-five years hence; should insist that underground distribution be provided, and should see that all work is done in a permanent manner.

A few of the photographs referred to are reproduced herewith by courtesy of Mr. Ford.

ALBANY AVENUE, HARTFORD, CONN., LOOKING WESTERLY FROM THE FOOT OF EAST STREET.

This single pole line carries the transmission line from Farmington River (over 11,000 volts). Arc light wires (varying voltage) and telephone wires, both open or bare and in cable.

EDITORIAL COMMENT

Municipal Ownership of Street Railways in Great Britain.

The Need of the Testing Plants at St. Louis.

MUNICIPAL OWNERSHIP OF STREET RAILWAYS IN GREAT BRITAIN.

In the latest bulletin of the United States Bureau of Labor, January, 1906, is a study of "Municipal Ownership in Great Britain," by Dr. F. C. Howe, which is worthy of careful reading. It shows the growth of the habit of municipal ownership and the reasons therefor. Municipalization of public-service industries has been a political question for some ten or fifteen years in that country, and has extended very rapidly, the enterprise which began the rapid development being the Glasgow street railways, which the city acquired in 1894. An earlier act, 1870, authorized cities to construct street-railway tracks and lease them to companies for operation. This operated satisfactorily so long as the cars were drawn by animals, but when electricity came in the conditions were so greatly changed that new contracts or new methods were demanded. Many of these leases expiring since 1894, the natural step, in the light of the apparent success at Glasgow, was for the city to retain the operation of its railway. This step was also justified by the poor service rendered by the companies whose franchises were expiring and who could not afford, therefore, to incur the heavy expense necessary to instal an electrical equipment. Dr. Howe states that public opinion indorsed the assumption of the street railways by the cities also by reason of the condition of the employes and the monopolistic character of the industry and the consequent feeling that the pronts, if any, should accrue to the city and its citizens. At present the number of municipally operated street railways is fully equal to the number of private street-railway companies, and the capitalization is much larger, since the large cities, including London, are now mainly operating their own lines. The measure of the industry by capitalization is not so misleading as it would be in this country, since the government has closer control over the financial operations of public-service corporations than we have yet deemed it necessary to assume.

The objections to municipal ownership are based on the great increase in municipal debts, increase in taxes on that account and consequent increase in cost of commodities and services, the political manipulation of employes, lack of capable business men among city officials, the actual unsoundness of plants which are made to show annual profits, the establishment of a bureaucracy, etc. These objections have a familiar sound.

The points advanced by the supporters of municipal ownership are the stimulation of public spirit, the reduction in cost of service because of financial success in operation, the improvement in the condition of labor, the prompt response to public criticism by improvement of service, etc.

With regard to street railways Dr. Howe's statistics indicate the following answers to these two classes of arguments:

As to increase in indebtedness and in taxes: The capital outlay to 1904 for 162 municipal street railways was $136,600,000, and the total indebtedness is somewhat less. The capital borrowed by 29 systems in England and Wales is reported at $40,800,000, and the amount already repaid at $2,290,000. Seven cities received from their street-railway systems in relief of taxation in 1903-4 sums ranging from $253,058 in Leeds to $55,965 in Hull. The total in all cities for the same year was $1,007,789. This was profit after charging $2,300,000 to depreciation, reserve and renewals and $2,300,000 to sinking fund or capital repayment, or a total of 3⅝ per cent. of the capitalization. Construction is very expensive under English conditions, the expense beginning with tens of thousands as cost of getting authorization of construction from Parliament and including heavy construction required by the Board of Trade. Nevertheless the twenty-nine boroughs above referred to had an average income for five years up to 1902 of $6,788,000, average working expenses of $4,728,000, average interest payments of $783,000, average repayment of $639,000, average depreciation charges of $240,000 and average net profits per annum of $398,000. This indicates that any burden added to an individual taxpayer is due to mismanage-

BELDEN STREET, HARTFORD, CONN., LOOKING WESTERLY.

Top cross arm carries two wires of one arc circuit and only one wire of another circuit—the worst condition for induction. Middle cross arm carries 220 volt wires—note service wires to house. Bottom cross arm carries two telephone wires—note twisted pairs of wires to two subscribers.

ment or to local conditions which do not prevail generally in the country. In addition to this each patron of the service in many of the cities receives a direct benefit through reduced fares. The estimates of these reductions are $876,000 a year in Glasgow, $1,606,000 in Liverpool, $486,650 the first year in London, etc.

The rates of fare are materially less in Great Britain than in the United States, ranging from an average of 1.3 cents in East Ham to 3.17 cents in Blackpool, and averaging on the whole not far from 2 cents, as against 4.94 cents in the United States. The service is reported to be less satisfactory on the whole, in part due to local conditions rather than difference in management.

Hours of labor of employes have been reduced under municipal operation to nine or ten a day for six days, and wages per hour have been increased, the total increase in labor expense in London having been $180,000 the first year and $195,000 in Liverpool.

A more liberal policy in meeting the demands of the public has resulted in large increase in patronage. The management expects to pay all charges against the plant and to expend as much of the surplus in bettering the service as possible. The result where the management is irreproachable is still greater profits.

All these results can be applied, with modifications, to American conditions, and so far as these questions are concerned the conclusions will be strongly in favor of municipal ownership and operation of street railways.

The political question has not yet been considered, and here is found the real difference which makes English results inapplicable unless we change our methods of city government.

Dr. Howe praises the "uniform efficiency, integrity and high purpose of British officials," and attributes them to several causes.

One cause is the traditional distinction that attaches to public service in Great Britain. We are just now passing through a stage of public opinion when the holding of public office is ground for suspicion of motives until the incumbent has shown by his acts and words that he is working for the public good and not for what he can get out of the office for himself or for his party.

In England the magnitude and importance of public work attract business and professional men of ability and character to the council, and there is a subordination to the city's welfare. Councilmen are nominated by petition, not party machinery, and elections are separate, so that there is no confusion of issues. With no franchises or privileges to give there is no inducement to organize to control elections. Every voter being a taxpayer, he has a direct interest in the proper expenditure of public money, which makes him careful in his selection of his representative. Before the United States can expect to meet with the same success in municipal ownership that is attained in England we must introduce a merit system which is effective in the choice of both elective officers and appointive employes. We could manage a little bureaucracy if we could get our municipal work well done and without interference.

There are signs that our present wasteful methods are becoming unbearable to the taxpayers, their effect upon pocketbooks becoming evident, and when this fact is fully recognized the time of the change will not be far distant. It is quite possible that the general assumption of municipal ownership, even of industries requiring the employment of so many men as street railways require, will hasten the day by making the situation more difficult, the dangers more obvious.

THE NEEDS OF THE TESTING PLANTS AT ST. LOUIS.

There are two series of investigations under way at the St. Louis testing plants of the United States Geological Survey, one of the fuels and the other of structural materials. Two large volumes of the report of the coal-testing plant for 1904 have just been published, one describing the field work, the classification of coals and the work of the chemical laboratory, and the other the boiler tests with the various coals. A third volume follows, showing the results of using the fuels through producer gas plants, as coke, in briquettes, when washed, etc. These volumes show the value of the work and that the $85,000 expended on the work in 1904 was well invested.

For the current fiscal year the appropriation was $202,000. This sum has thus far paid for more than 1,600 chemical analyses of coals, 85 gas producer and gas engine tests of coals from 18 States, 283 steam boiler tests on 170 coals from 18 States, 110 coke oven tests on 95 coals from 16 States, many heretofore classed as non-coking, washing of 43 coals from 13 States and briquetting of fine coals.

Investigations are needed on methods of preparing coals for use, on methods of burning under boilers, on the use of gas producers and gas engines, etc., and these investigations canot be made on sufficiently large scale by private parties. They are expensive, the results are of

ALBANY AVENUE, HARTFORD, CONN., LOOKING WEST FROM GARDEN STREET.

Poles on the left carry on the five upper cross arms, wires of The American Telephone & Telegraph Co. (trunk line to New York and Boston.) On the sixth cross arm, local telephone wires, both open and in cables. On the seventh cross arm (bottom), 220 volt arc wires of The Hartford Electric Light Company.

exceedingly great value to all users of fuel, and few, if any, corporations are fitted with men or facilities for the work or are willing to expend the large sums necessary when they will derive but a small part of the benefit therefrom. Should all those interested begin the experimentation necessary there would be enormous waste from duplication of laboratories, apparatus and materials, not to speak of the duplication of work and the vast losses through useless experiments undertaken because those in charge of them are not informed as to the negative results of other experimenters. The sum asked for the extension of the investigations is an infinitesimal part of the savings which may result from them.

The other branch of work, that of investigations of structural materials, has been going on in a small way and in restricted fields, mainly cement manufacture and use, since 1902. In 1905 $12,500 was appropriated for investigations, mainly of cement and concrete as structural materials, and several lines of investigation are now laid down. The results of the limited series of experiments have been so valuable that it is now recognized that their continuation and extension are most important. There has been some attempt at experimentation by colleges, insurance companies and others, but the facilities available have been so slight, especially as to competent men available for the work, and the methods have been so diverse that but little has yet been accomplished and the few results are obtained under such varying conditions that it is practically impossible to correlate them. The use of structural materials is so universal that their study should be made under a central bureau which can be given ample materials and assistance and can publish results of value to all those interested, practically every citizen of the United States. We know now that we are very extravagant in our use of cement, but we do not know the methods of combination of materials or the kinds of materials which will warrant us in reducing the proportions of cement in our mixtures. A few thousand dollars expended in experiments will save many thousand dollars a year to the cement users of the country. The same is true to greater or less extent of other materials, sand, clay, stone, clay products, steel, etc., and when all the structural materials are considered we again have a group of industries in which practically every citizen of the United States is interested. The arguments for a laboratory under national government patronage are, then, the same as those presented for the fuel-testing plant.

Call has been issued for all those interested to request the attention of their congressmen to the subject and to ask their favorable consideration.

THE QUESTION DEPARTMENT

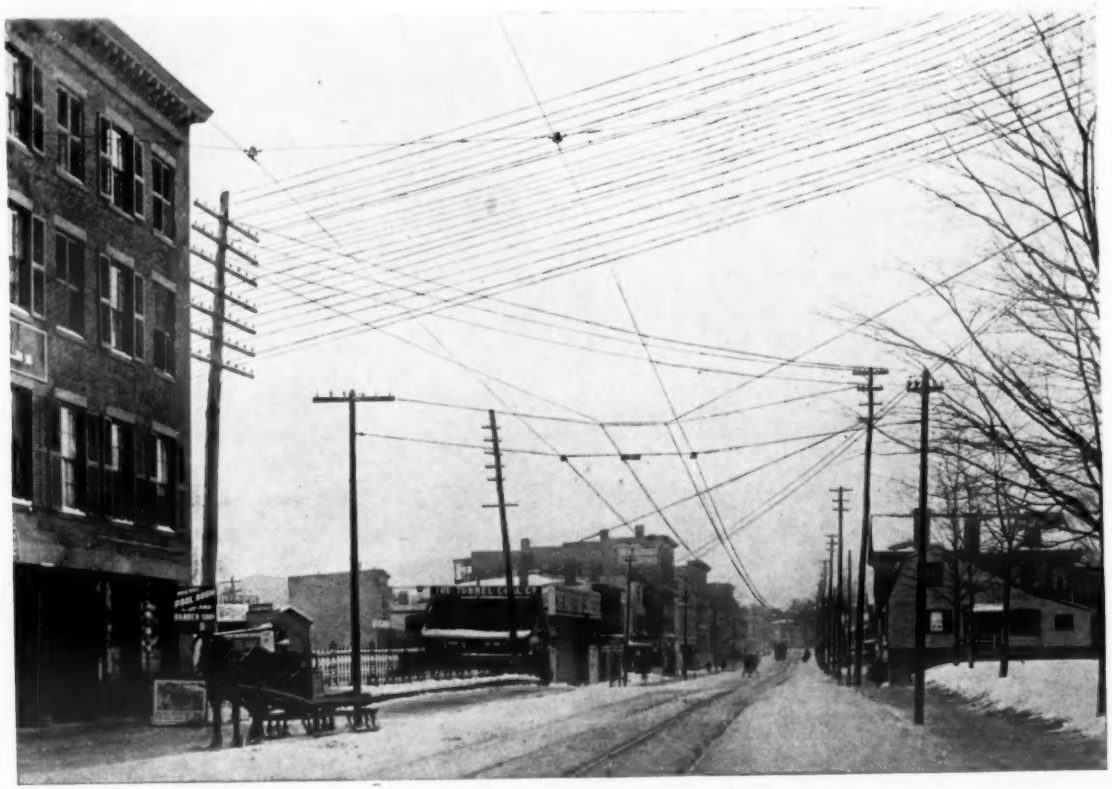
FILING AND INDEXING CITY ENGINEER'S RECORDS.

I am very anxious to index and classify the drawings and maps on file in this office, using a system which is considered the best at the present time, and which can be used for a good many years to come by being added to. Following are some questions covering the points. Do you know of any city that has an up-to-date method for filing?

1. What system do you use for indexing maps, drawings, etc., on file in your office? Card, loose-leaf binding, or special index book?
2. Are you satisfied with it, or would you prefer some other system, and if so, what?
3. Are your drawings numbered consecutively from one up, and classified into different subjects, for filing, such as sewers, pavements, real estate maps, etc., and how?
4. What sizes are your standard drawings?
5. Would you think either 8½x11 (letter size) or 8½x13 (legal size) a good standard as a basis for standard-size drawings, such as 8½x11 or 13; 8½x22 or 26 8½x33 or 39; 17x33 or 39; 26½x33 or 39; 34x44 or 52, in other words, using multiples of either of the above sizes? If so, which size?
6. Are your drawings filed flat in drawers or rolled?
7. Are your record maps and profiles of sewers in detail as built, made on cloth back paper, and bound in book form, or are they made on profile paper or tracing cloth, and what size?

HENRY E. BAKER,
City Engineer, Watertown, N. Y.

The writer has found the card index



ALBANY AVENUE, HARTFORD, CONN., LOOKING WESTERLY FROM THE TUNNEL.

The three wires crossing from the first tall pole on the right to the left side of Albany Avenue carry 11,000 volts from the water power station of the Farmington River Power Company to the terminal house on the left. Note the large number of through wires of the telegraph company from the second large wooden pole on the left crossing Albany Avenue with no protection from these high tension wires.

system the most satisfactory. The street records are indexed on cards of different colors, white for paving, salmon for sewers, blue for plats, and so forth, all being filed under the street name and plats also under the name of the addition or subdivision. It has been found very satisfactory.

The completed drawings for plans of sewers, pavements, plats, etc., are made on sheets of cloth-backed paper, the sizes being selected to begin with to suit the conditions of the city and the office. Where streets are nearly level the plans and profiles can be put on the same sheet, one above the other, and still permit narrow sheets, especially in street paving work. These plats are bound in volumes, each containing about 30 sheets, sewers, pavements and plats in different volumes, lettered and numbered. The card index refers to these books, and the index to note books is on the same card.

The standard sizes named should be satisfactory. Scarcely any two hit upon the same sizes, except by accident, and before the sizes are adopted one should estimate very carefully the probable needs for the various streets, so that there may be as few deviations from the standard sizes or methods of platting as possible. The books are more satisfactory for drawings which are completed. Those which are under construction are filed temporarily in drawers of suitable size, and sometimes remain there for some time before reaching the binding stage.

The index maps, showing city districts, subdivisions, sewers, kinds of pavement, pipe lines, etc., are mounted on spring rollers and filed in a wall case, so that they can be consulted by pulling down and thus unrolling to view. As few maps as possible are rolled, but those which it is impossible to reduce to the standard sizes are so filed.

Tracings of all plans for improvements are made and filed with the resolutions for the improvements, blue prints being made for filing with the copies made for various offices and for contractors.

The sizes of the plans and tracings for these improvements approximate the three largest sizes mentioned in the questions. Standard plans for details, and plans for special work, such as bridges, culverts, basins, inlets, etc., up to track elevation plans, are made on the sizes necessary and are filed in drawers, those of a kind together, and the drawers are shallow, so that seldom more than four sets of plans for different structures of the same class are in the same drawer.

Many cities now have excellent systems of filing and indexing. As examples of good systems on differing plans the city engineer's offices of Brookline and Cambridge, Mass., Jamestown, N. Y., and Indianapolis, Ind., may be mentioned. They are all applicable to Watertown, and it is probably a matter of opinion and of education as to which is preferable.

SCHOOL OF ENGINEERING AND CONTRACTING.

Can you direct me to a school or correspondence school where I can fit myself for regular engineering and contract work? J. B. L., Wellersville, O.

The technical schools in the great universities, private and State, and those which are devoted to purely technical subjects are the best. Ohio has its own State University at Columbus, the University of Cincinnati, the Case School of Applied Science, at Cleveland, and others, and almost every State is supplied with similar schools. Those who have not the preparation required for such a course can find schools where they can get instruction in the more elementary branches. There is, for example, an engineers' academy at Greenville, O. The correspondence schools are also doing as good work as their students are willing to follow. Perhaps the most prominent of these schools are the International Correspondence Schools at Scranton, Pa., and the American Correspondence Schools, Armour Institute, Chicago, Ill.

BOOKS ON BUILDING CONSTRUCTION.

What is the best book published on building construction? P. S., Auburn, N. Y.

Kidder's "Architects' and Builders' Pocket-Book ($5) is an excellent book on building construction, and is large enough (1,653 pages) to cover most of the ground very thoroughly. It is reviewed in MUNICIPAL ENGINEERING, vol. XXVIII, p. 462.

Richey's "Handbook for Superintendents of Construction, Architects, Builders, and Building Inspectors" ($4) is another book, smaller (744 pages) and treating the subject more directly from the standpoint of the inspector and superintendent. It is reviewed elsewhere in this number.

There are many books on various details of building construction, and books in several volumes, which go into still greater detail, such as Kidder's "Building Construction and Superintendence" in three volumes on "Masons' Work" ($4),

ASYLUM STREET, HARTFORD, CONN., LOOKING WESTERLY FROM THE RAILROAD BRIDGE.
Trolley feeders and Electric Light Company's main feeder circuits. A most unsightly entrance to one of the main avenues.

"Carpenters' Work" ($4), and "Trussed Roofs and Roof Trusses" ($4).

There are also many books on the various branches of the building trades, such as Maginnis's "Bricklaying ($1.50) and "How to Frame a House" ($1), "Notes on Building Construction," in four parts, the first two at $3.50 together, treating of construction methods, the third part ($6) of materials and the fourth part ($4.50) of methods of calculation for building structures, etc.

HOW TO APPLY FOR PLACES ON THE PANAMA CANAL.

Can you tell me what are the regulations governing application for places on the Panama Canal?

SUBSCRIBER.

The following extracts are made from the circular of information concerning conditions of employment under the Isthmian Canal Commission, which is issued by the United States Civil Service Commission:

"On November 15, 1904, the President, by Executive order, placed the employees of the Isthmian Canal Commission under the provisions of the civil-service act and rules, excepting persons employed merely as laborers, persons whose appointments are confirmed by the Senate, and engineers detailed from the United States Army.

"Vacancies in clerical and other positions in the office of the Canal Commission in Washington will be filled as far as practicable from suitable existing registers of eligibles, and for positions on the Isthmus of Panama examinations will be held at various cities throughout the United States and also upon the Isthmus, as the needs of the service may require.

"The age limits for entering the service are 18 to 40 years, unless otherwise expressly stated in announcements of examinations. These limits, however, do not apply to applicants entitled to preference under Section 1754, Revised Statutes.

"For the further information of applicants and others, the following statement is published relative to conditions of employment on the Isthmus of Panama under civil service rules by the Isthmian Canal Commission.

"Employes Whose Salaries are Fixed on a Monthly or Annual Basis.—The salaries of such employees begin upon the date of embarkation at port of departure from the United States. They will be granted free transportation from port of departure, which includes meals on steamer, but will be required to pay all expenses of the journey to such city, which are not to be refunded. Where practicable, and in the best interests of the service, they will be provided with such quarters on the Isthmus as may be available from time to time, and if such quarters are not available, they will be granted, in lieu thereof, a sum, payable monthly, equal to 15 per cent. of their monthly compensation.

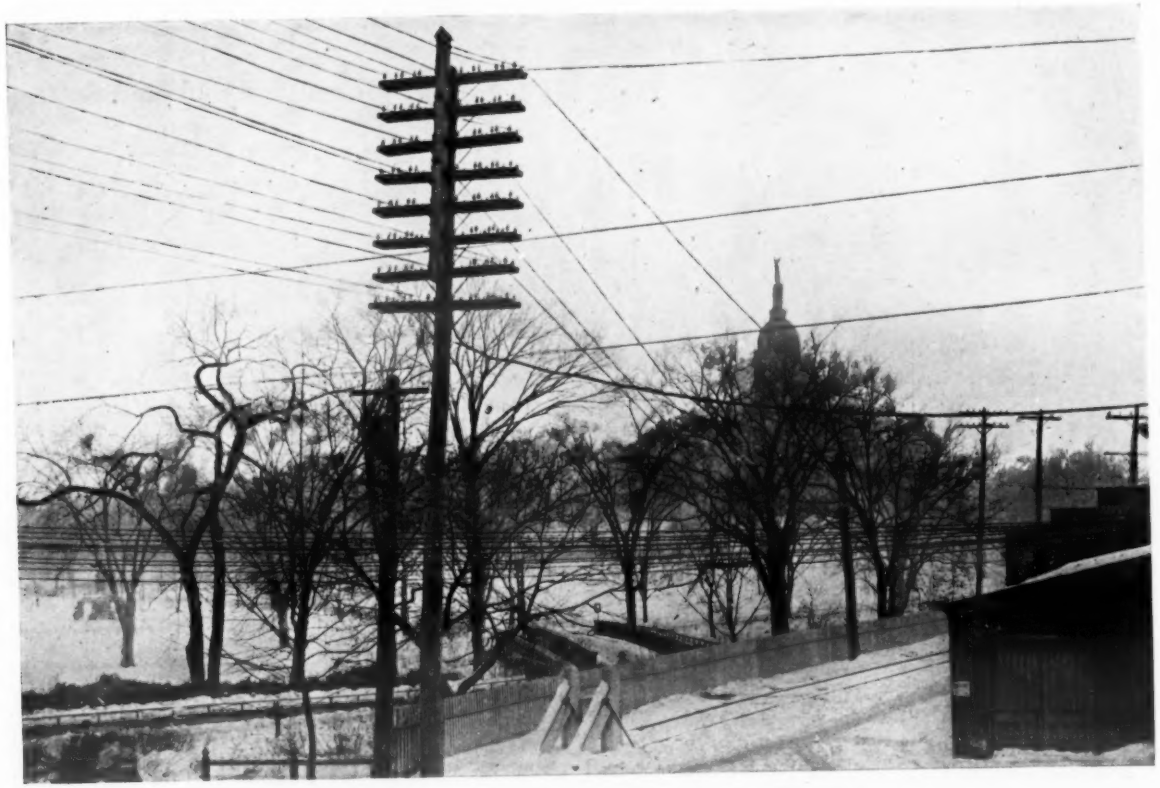
"They may be granted, in the discretion of the department in which employed, leave of absence at the rate of six weeks for every twelve months of service rendered, or at the rate of three and one-fourth days for each full month's service actually rendered, such leave to be accumulative for a period of two years, and to be granted at any time after eight months' service, in the discretion of the head of the department. If such leave is granted, they will be entitled to the Government rate of $20 each way on the steamers of the Panama Railroad and Steamship Company, operating between New York and Colon. The grant of a leave of absence is not considered a vested right, but is made to promote the welfare and interests of the service, and compensation for the period of their leave will not be paid until after their return to duty.

"Employees whose salaries are fixed on a monthly or annual basis will receive no extra pay for overtime work required of them.

"Employees Whose Compensation Is Fixed on an Hourly Basis.—Employees appointed with rate of pay per hour will be allowed compensation on a basis of an eight-hour day from the date of departure from port of embarkation until they actually enter upon the performance of their duties, after which time their wages will be based on an eight-hour day with time and a half for overtime work, including Sundays and holidays, but will not be entitled to any leave of absence with pay. They will be granted free transportation from port of departure in the United States, including meals, but will be required to pay all expenses of the journey to that city, which are not to be refunded. Where practicable and in the best interests of the service, they will be provided with such quarters on the Isthmus as may be available from time to time, and if such quarters are not available, they will be granted, in lieu thereof, a sum, payable monthly, equal to 15 per cent. of their compensation, based on 208 hours per month.

"Medical Attendance.—Free medical and hospital attendance in case of illness is provided.

"Return Transportation.—Free trans-



BUSHNELL PARK, HARTFORD, CONN., FROM UNION STATION.

Shows Western Union Telegraph wires and trolley feeders marring the beautiful view into Bushnell Park.

portation is provided to a port of the United States upon the termination of satisfactory service, the character and length of such service to be determined by the head of the department.

"Transportation of Families.—Members of the immediate families of employees will, upon request, when the exigencies of the steamship service permit, be granted the Government rate of $20 between New York and Colon. No charge will be made for children under 6 years of age, and half rates will be charged for children between the ages of 6 and 12 years. Employees will not be permitted to take their families to the Isthmus until they have gone there first and secured quarters for them.

"Reinforced Concrete ($7); Potter's

"All inquiries concerning examinations for competitive positions under the Isthmian Canal Commission should be addressed to the United States Civil Service Commission, Washington, D. C."

SEWAGE AND DYE WASTE DISPOSAL.

Can you give me a list of some towns or cities using the pail system of removal of night soil? Do you know of any place where the purification of sewage in septic tanks and contact beds (double) is successful with dye wastes in the sewage? What is the customary requirement as to discharging cotton-mill dye wastes into sewage which has to pass through a disposal plant? Can you tell me of any place which successfully handles dye wastes without nuisance, where there is no stream to receive it?

G. C. W., Durham, N. C.

There is no example of the pail system in this country, so far as the writer knows. The city of Rochester, N. Y., at one time applied the system to summer cottages on the shores of Hemlock Lake, which is its water supply, but changes have been made whereby the former thorough application of the system is not now necessary, though in use to some extent. Rochdale, England, population about 84,000, is the only city which uses the system for the general service.

There is no place in e,ther America or England, known to the writer, in which dye wastes are successfully treated by bacterial processes. Where the streams are too small to receive the waste without nuisance the mills have been forced by the courts, in some cases, to put in sedimentation or chemical precipitation processes to reduce the liquids to an innocuous condition before discharging into stream or sewer. Examples are given in Baker's "British Sewage Works" ($2) and in Rafter and Baker's "Sewage Disposal in the United States" ($6), "Naylor's "Trades Waste, Its Treatment and Utilization," and the chapter on trades waste in Rideal's "Sewage" ($3.50) give indications of methods of purification in use in England.

PAYMENTS FOR STREET RAILWAY FRANCHISES.

I am very anxious to get information as to the terms on which street railway companies in cities of the United States of fifty thousand (50,000) inhabitants, about, obtain franchises from the cities; that is, what amount and in what manner do they pay for their franchises.

A. F. P., Ogden, Utah.

The special report on street and electric railways for 1902 issued by the United States Census Bureau, gives quite full information in regard to the franchise requirements of street railway companies. It can be obtained on application to the United States Census Bureau, Washington, D. C., and is doubtless on file in libraries in Ogden and Salt Lake City.

On pages 136 to 148 of this report will be found digests of the laws of various States governing street railway franchises. As regards payment for franchises, the data are as follows:

California: Franchise must be sold to highest bidder and after five years of operation must in addition pay 2 per cent. of its gross receipts to the local government, with special provision in San Francisco for new charters of 3 per cent. for first five years, 4 per cent. for next ten, and 5 per cent. for last ten years of franchise period. Car license fees of $25 per car ($50 in San Francisco), may be collected also.

Georgia: In Atlanta (pop. 89,872) the street railway paid 1 per cent. of its gross earnings during the first three years, and pays 2 per cent. for the next twenty years, and 3 per cent. thereafter until expiration of its various franchises. A cash payment of $50,000 was also made. Savannah (pop. 54,244) charges $25 a year for each car and $100 for each mile of track.

Illinois: Chicago and Peoria (pop. 56,100) charge $25 a year for each car.

Indiana: Indianapolis requires payment of $30,000 a year up to 1925, and $50,000 a year thereafter until end of franchise. Evansville (pop. 59,007) requires 2 per cent. of gross receipts for 12½ years, then increasing gradually to 4 per cent. for last 12½ years of 50-year franchise. In 1902 this payment amounted to $3,485. Ft. Wayne (pop. 45,115) requires 2 per cent. of gross receipts and $1 a year on each pole, amounting to about $8,000 a year. Terre Haute (pop. 36,673) required $78,000 cash for a recent 14-year extension of franchise.

Iowa: Des Moines (pop. 62,139) requires 5 per cent. of gross earnings from

COLLINS STREET, HARTFORD, CONN., AT THE CORNER OF SIGOURNEY STREET.

Showing the best method of handling overhead telephone wires. Cable ends in box on pole at left. Twisted pairs of wires, one for each subscriber, run through rings along cable through trees on north side of Collins Street. This plan requires much less room than open wires, is more sightly and does less injury to trees.

mail, express and freight traffic and a percentage of its net earnings in lieu of other taxes, but the ordinary property taxes have been paid on claim that there are no net earnings. Sioux City (pop. 33,111) requires $25 a year per car.

Kentucky: The State law requires sale of franchises to highest and best bidder, but no regular payments are reported, except from Frankfort, which is said to have received an unstated amount for extending franchise.

Louisiana: Recent laws require letting of franchises only to bidder offering highest percentage of gross receipts, but no franchises have yet been let under them.

Maryland: Baltimore receives 9 per cent. of gross receipts and a low car license fee, amounting in all in 1902 to $324,398.

Massachusetts: In addition to special State taxes, the street railroads pay in lieu of paving and sweeping tracks and removing snow a percentage of gross earnings, varying from 1 per cent. for earnings of less than $4,000 a mile a year to 3 per cent. for more than $28,000. The average payments by street railroads on this account in 1902 were nearly 1¼ per cent. of gross receipts, the total of all taxes being nearly 7 per cent. of the gross receipts.

Michigan: Some of the lines in Detroit pay from 1 to 2½ per cent. of gross receipts.

Minnesota: New franchises in St. Paul must pay at least 5 per cent. of gross receipts, but there are at present no new franchises.

Missouri: Cities of over 100,000 population must let franchise to highest bidder, but this has not yet been applied. Such cities may also tax passengers, cars or gross receipts through franchise provisions. St. Louis received $105,858 in 1902 from such special percentage taxes and $24,750 from car license fees at $25 a car.

New Jersey: Newark requires 5 per cent. of gross receipts and $10 a car, and received $86,797 therefrom in 1902. Paterson requires 2½ per cent. of gross receipts, amounting to $14,636 in 1902.

New York: Competitive bidding for franchises is required in some cities, and lines constructed since 1884 must pay 3 per cent. of gross receipts during first five years and 5 per cent. thereafter, and another law permits other cities and villages to require 3 per cent. of gross receipts. New York City received from its various special payments of this sort and a $50 license fee on cars, $422,177 in 1902. Rochester requires 1 per cent. of gross receipts and small car license fee, amounting to about $30,000 a year. Buffalo receives 3 per cent., making $85,851 in 1902.

Ohio: Cleveland has car license fee of $10. One Columbus company pays 2 per cent. of gross receipts. Cincinnati requires 6 per cent. of gross receipts, amounting to about $200,000 a year.

Oregon: Portland required $1,000 a year for first five years, increasing gradually then to $5,000 a year for last five years of 30-year franchise. Another company pays $3,000 and $12,000 respectively for same periods.

Pennsylvania: Philadelphia companies pay car license fees of $50 a year, amounting to about $100,000 a year. Cities of second and third classes may levy car license fees. Harrisburg (pop. 30,167) requires 3 per cent. of gross receipts, amounting to about $2,900 a year.

Rhode Island: The State may receive a percentage on gross receipts under certain peculiar circumstances. Providence receives 5 per cent. on gross receipts within its limits, amounting to $66,195 in 1902. Woonsocket (pop. 28,204) receives 3 per cent., amounting to $1,631 in 1902.

Virginia: The new State constitution requires hereafter competitive bidding on franchises. Richmond requires from leading system 5 per cent. of gross receipts, amounting to $28,121 in 1902. Norfolk (pop. 46,624) requires 4 per cent., amounting to $20,000 a year.

West Virginia: Parkersburg requires competitive bidding on franchises, on the basis of an annual payment to the city. Wheeling (pop. 38,878) recently gave a franchise requiring payment of $300 a mile of line for first twenty years and $1,000 a mile for last thirty years of 50-year franchise.

Wisconsin: LaCrosse (pop. 28,895) requires 3 per cent. of gross receipts.

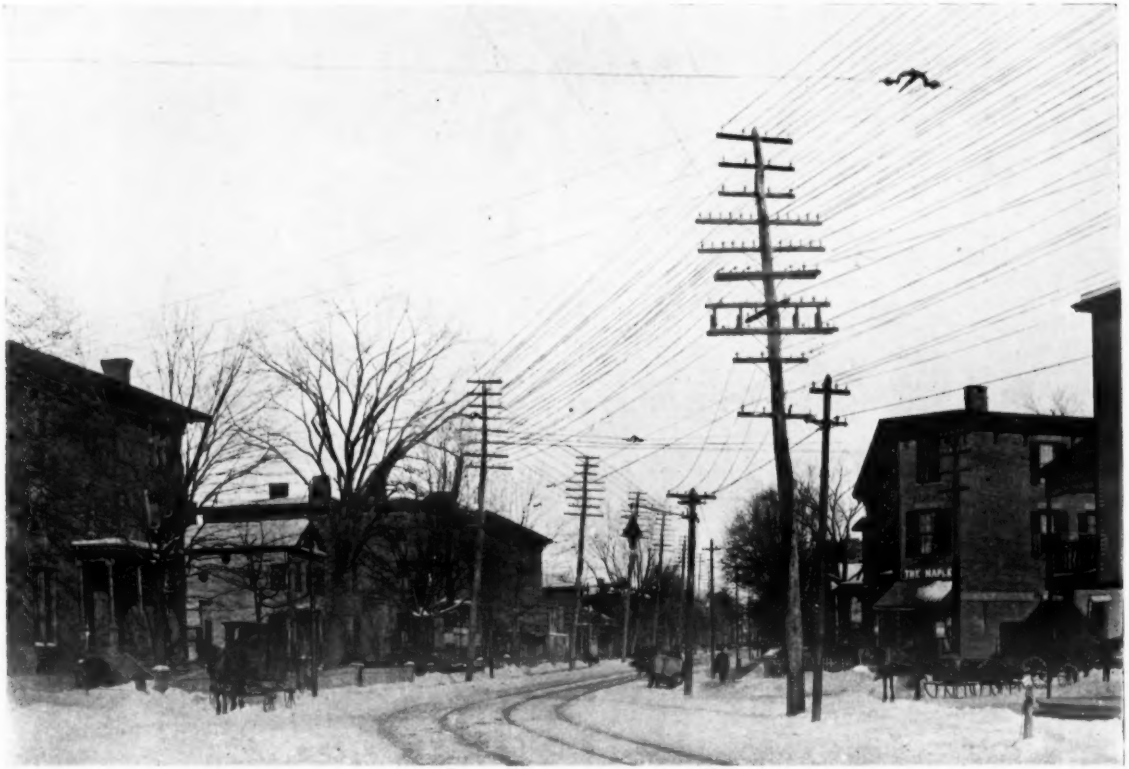
Requirements as to paving, cleaning, removing snow, fares and transfers are important factors in fixing payments for franchises. With the following exceptions the fares in the smaller cities named above are 5 cents, and reference must be made to the census report or the original franchises for the details which really influence the payments for the franchises.

Peoria, Ill., fixes fares at 12 tickets for 50 cents, or 100 for $4, and Rockford and Springfield sell 25 tickets for $1.

Indianapolis, Ind., sells 6 tickets for 25 cents, or 25 for $1.

St. Joseph, Mo., sells 100 tickets for $4.

In Ohio the bidding for franchises is usually on the basis of the lowest fare rather than the highest percentage of gross receipts. Columbus requires 7 tickets to be sold at 25 cents and after gross receipts of company reach $1,750,000 at 8 for 25 cents, and one company pays in addition 2 per cent. on gross receipts. Cleveland sold 6 tickets for 25



MAPLE AVENUE, HARTFORD, CONN., LOOKING NORTHERLY FROM FRANKLIN AVENUE.

Large pole in foreground carries on the three upper cross arms the wires of the Postal Telegraph Co., on the fourth and fifth cross arms, those of the local telephone. On the lower five cross arms are the main line wires of the Hartford Electric Light Co. to Wethersfield, 2,400 volt arc light wires and 220 volt service wires, showing unsightly fuse boxes. The large poles on the left of Maple Avenue can now be removed as the Southern New England Telephone Company built a conduit in Maple Avenue last year.

cents for a while and now sells 11 tickets for 50 cents.

Richmond, Norfolk and Danville, Va., sell 6 tickets for 25 cents.

AMOUNT AND COST OF STREET CLEANING.

Can you give the amount and cost of street cleaning by hand and by machine in the larger cities of the country?

B. S. H.,
Paul's Valley, I. T.

Bulletin 20 of the United States Census gives some figures on the amount and cost of street cleaning, from which the following are derived for cities of more than 100,000 population:

City.	Av. No. Sq. Yds. Swept Each Week.	Persons Employed	Total Cost for Year 1905.	Cost Sq. Yd. Cleaned 1 Time (Cent.)
New York, N. Y.	a224,693,583	2,890	$5,540,169	0.047
Chicago, Ill.	b 16,512,000	450	243,040	0.028
Philadelphia, Pa.	c 74,692,412	1,080	687,767	0.018
St. Louis, Mo.	b 3,000,000	550	547,627	0.351
Boston, Mass.	.....	711	472,290	....
Baltimore, Md.	a 7,092,267	285	214,482	0.581
Cleveland, O.	b 6,674,236	308	144,161	0.042
Buffalo, N. Y.	a 10,802,859	200	150,425	0.027
San Francisco, Cal.	c 6,600,000	210	196,447	0.057
Pittsburg, Pa.	b 10,200,000	500	246,366	0.046
Cincinnati, O.	b 6,500,000	255	235,851	0.070
Milwaukee, Wis.	.....	400	103,547	....
Detroit, Mich.	.....	...	187,750	....
New Orleans, La.	b 3,096,633	175	92,307	0.057
Washington, D. C.	a 16,061,670	314	216,767	0.026
Newark, N. J.	b 2,497,651	300	117,674	0.091
Jersey City, N. J.	c 1,500,000	100	71,915	0.092
Louisville, Ky.	b 2,932,400	155	83,868	0.055
Minneapolis, Minn.	b 4,175,946	369	.....	....
Indianapolis, Ind.	c 5,239,260	175	80,641	0.030
Providence, R. I.	b 725,233	99	58,232	0.154
Kansas City, Mo.	b 15,500,000	125	78,636	0.001
St. Paul, Minn.	b 2,454,836	181	37,454	0.029
Rochester, N. Y.	a 5,050,000	315	90,152	0.034
Denver, Col.	b 5,491,200	130	62,711	0.022
Toledo, O.	b 4,825,110	154	100,532	0.040
Allegheny, Pa.	b 6,927,840	95	62,206	0.017
Columbus, O.	b 4,300,000	125	43,942	0.020
Worcester, Mass.	d 895,747	77	39,284	0.084
Los Angeles, Cal.	a 3,228,104	265	35,755	0.021
New Haven, Conn.	b 1,556,535	66	43,766	0.054
Syracuse, N. Y.	d 6,067,728	174	59,431	0.019
Fall River, Mass.	d 513,013	66	26,798	0.100
Memphis, Tenn.	d 800,000	80	13,581	0.033
Omaha, Neb.	.....	...	18,323	....
Paterson, N. J.	b	110	26,113	....
St. Joseph, Mo.	b 269,100	37	16,038	0.111
Scranton, Pa.	b 685,536	36	20,100	0.056
Lowell, Mass.	d 325,000	65	17,892	0.106

a. Work done party by city and partly by contract.
b. Work done by city.
c. Work done by contract.
d. Employes paid partly by city and partly by contract. Area cleaned is all in City column.

New Orleans, La., Rochester, N. Y., St. Joseph, Mo., Scranton, Pa., clean their streets by hand. All the others use both the machine and hand methods. The cost in all these except Rochester is materially above the average of the thirty cities which are not anomalons.

Following is additional information from Indianapolis:

In 1905 the cost of cleaning 184,620,482 square yards of permanently improved streets was $54,451.84, or 0.021 cent a square yard. This is said to be a saving of 9.3 cent per 10,000 square feet over the contract cost of the previous year, making the total cost under the contract system for 1904 0.030 cent per square yard. In 1905 equipment was purchased costing $26,048.15, the cost of which is not included in the cost of street cleaning. Interest and depreciation on this sum are also not included. If they were included at, say, 20 per cent., the cost of street cleaning in 1905 would be increased to about 0.024 cent per square yard. The items of cost are $45,336.48 for pay roll, $7,212.06 for stable and feed, $1,037.42 for repairs, $845.73 for miscellaneous and the $5,209.64 for interest and depreciation.

The average of all the costs per square yard given in the table is 0.076 cent. The cost in Baltimore is excessive, probably on account of the character of the streets and the thoroughness of the work, and that in St. Louis is somewhat large, perhaps on the same account. The cost in Kansas City is anomalous, possibly because the cost is computed on the total area of

streets rather than upon the area of those which there is a real attempt to clean. Omitting these three from the table, the average of cost on the remaining thirty cities is 0.053 cent per square yard. It will be interesting for those who know something of local conditions to compare the figures and to see whether departures from the average are due to character of paving, to the degree of cleanliness of the city, to political influences or other conditions aside from the efficient and economical prosecution of the work.

THE BEST BLOCK MACHINE—CEMENT BRICK.

There are so many block machines it is hard for one to choose the best and I would like a little advice, as I expect to go into the block business.

I notice there are machines made for blocks split, that would be lighter to handle.

Is the cement brick a success?

H. H. C., Warsaw, N. Y.

The principles upon which a concrete-block business should be founded have been discussed frequently in MUNICIPAL ENGINEERING, with direct reference to the mode of procedure advisable in starting a business in such articles as those in vol. xxvi, pp. 313 and 389, and in general in such articles as the series by Louis H. Gibson, which began in the number for December, 1905.

The first requisite is a knowledge of cement and of the other materials from which to make blocks, and of how to put them together and how to cure the blocks after they are made. The kind of machine used has very little to do with the quality of the block made, for good blocks can be made by an expert in almost any machine.

When one has learned how to make a good block, however, the question of machine is an important one from the standpoint of economy of time and labor in making the blocks. The quality of block made on a given machine depends to some extent upon the rapidity with which it is made, but much more upon the care with which it is made, and the amount and kind of tamping. The removal of blocks from the machine without jar and transferring and storing without disturbance of the green concrete are also factors in the construction of good blocks. These items are independent of the machine, but some machine are more favorable than others. The size of blocks and the designs of blocks are also in a way independent of the adjustable machine, but a large part of the work of a block factory will be on standard-sized blocks and sometimes a judicious selection of a non-adjustable machine will give the best results. Such machines must be selected to suit the demands of the locality, for, although the trade can be forced to take a block not exactly satisfactory to a certain extent, attention to the demands of the architects and builders will bring in the best business results.

There are machines which make large blocks, others which make medium-sized blocks, others small blocks, hollow or solid, and others which make the so-called two-piece blocks and adjustable machines which make two or more of these varieties. The demands of the local trade will determine how many sizes will be necessary.

It is usually true that a block factory with a good business must have more than one kind as well as more than one size of machine. One can only decide these matters properly after a careful study of the local conditions and the demands of the local trade and must add to his machinery as the trade develops and the demands change.

SPECIFIC GRAVITY OF PORTLAND CEMENT.

Kindly tell me what is meant by "specific gravity of Portland cement shall not be less than 3.10 nor more than 3.25." Does that mean that, taking water as one, the weight of the cement shall exceed the weight of water not less than 3.10 or more than 3.25 times? Taking water according to Kidder at 62.421 would make the cement weigh from 193.5 to 202.87 pounds per cubic foot, while of the cement that I have handled, very many different brands range from 95 to 103 pounds to the cubic foot.

S., Maquoketa, Ia.

The weight of Portland cement per cubic foot is obtained by weighing the loose or packed cement in its package or in a box, when it contains a large percentage of air. The specific gravity is obtained for the solid cement, and the weight per cubic foot as computed in the question is the weight which the cubic foot of cement would have if it were absolutely solid, all cement and no voids. The variation in weight between loose and packed cement is some indication of the reduction in voids which can be made by compressing the cement, but this process fills only a small percentage of the actual voids in the cement. The difference in weight per cubic foot of solid limestone and limestone dust gives some idea of the reason for the difference between the weight per cubic foot of cement determined from the specific gravity and by weighing the cement.

MAKERS OF CEMENT-BLOCK MACHINERY.

I am figuring on manufacturing cement building blocks in my locality and have been referred to you by the Lehigh Portland Cement Company for information. Will you please give me the names of firms that manufacture machinery and forms.

J. W. M., ————, Ind.

Reference should be made to the "Business Directory" printed in each number of MUNICIPAL ENGINEERING under the headings "Concrete Blocks" and "Concrete Construction Machinery." There is scarcely a number of this magazine for the past four years which does not contain some information about concrete block manufacture. Attention is called in particular to the series of articles by Louis H. Gibson which began in the December number. The numbers for February, 1905, and February, 1906, contain the proceedings of the conventions of the National Association of Cement Users, and cement blocks had their full share of attention at these meetings. The proceedings are also published in annual volumes by the Association.

ARE CONCRETE CHIMNEY BLOCKS FIREPROOF?—WET AND DRY PROCESSES.

Can you give me any information regarding the concrete chimney blocks as a fireproof material. Would you advise using them if they were laid with a good, tight mortar joint, and do you think they are perfectly safe? Of the two, which would you consider the better, the wet or dry process?

GEO. BLAIN, Waverly, Iowa.

Good chimney blocks, well laid, are reported by those who have used them to be entirely satisfactory. It should not be difficult to make joints which will be tight and durable, using cement mortar, and the materials ordinarily used in concrete blocks withstand the heat of a chimney without damage. The consensus of opinion at the Milwaukee convention of the National Association of Cement Users was that blocks made by the dry process should have as much water as they can carry without sticking to the molds unduly or falling down, and that, whatever the amount of water used in making the blocks, they should be supplied with plenty of it during the process of curing, the water being applied frequently for at least three days and preferably for a week or more. The wet process is a slower process and thus far has been more expensive, mainly on this account. The character of the process to be used depends upon several points and it can not be said that one is always better than the other, although it is the general belief that well-made blocks by the wet process are more dense and somewhat stronger, and the wet process has been used for monumental work almost exclusively.

INFORMATION ABOUT REINFORCED ARCH CONSTRUCTION AND BRICK PAVEMENTS.

Could you advise me where I could get information about concrete-steel arch construction? Also where I could learn how to build concrete brick pavements and the cost of laying brick.

J. B. GAYER, ————, O.

The "Handbook for Cement Users" ($3) gives specifications for reinforced concrete arch construction. Other books containing some information are Buel and Hill's "Reinforced Concrete" ($5), Taylor and Thompson's "Concrete, Plain and Reinforced" ($5), and Marsh's "Reinforced Concrete" ($7). The booklets issued by the concrete-arch designers will give some information also. Reference for their names may be made to the "Business Directory" printed in each number of MUNICIPAL ENGINEERING under the headings "Bridges" and "Concrete Steel Arch Bridges."

Concrete brick pavements have not yet come into use, though they have been suggested and, it is said, have been tried in Europe. Information about ordinary pavements, including cost of laying, will be found in Baker's "Roads and Pavements" ($5), which will be of value in estimating the cost of concrete-brick paving.

BOOK ON CONCRETE CULVERTS AND BRIDGES.

Please refer me to books on concrete culverts and bridges.

F. E. B., Jamaica, Ia.

The following books will give more or less instruction on this subject:

Taylor and Thompson's "Concrete, Plain and Reinforced" ($5); Sabin's "Cement and Concrete" ($5); Buel and Hill's "Reinforced Concrete" ($5); Marsh's Concrete" ($3).

MUNICIPAL ENGINEERING can supply any of these books on receipt of the price.

STRENGTH OF HOLLOW CONCRETE BLOCKS.

Will you please send us report of some tests that have been made for the compression and tensile strength of concrete blocks that have come under your observation. What we wish to know are the requirements, and if the tests made have met the same.

ILLINOIS GRAVEL CO.

The following figures are given for the compressive, tensile and breaking strengths

of concrete building-blocks in various numbers of MUNICIPAL ENGINEERING:

In vol. xxvi, p. 457, the crushing strength of a block is said to be over 1,600 pounds per square inch; the capacity of the testing machine having been reached; proportions being one part Portland cement and five to eight parts of sand and gravel.

In vol. xxvi, p. 427, the average of eleven results given in table is 841 pounds per square inch compressive strength for full-sized blocks of proportions about 1 to 4 and 1 to 5, none of them old enough to have reached their full strength. The average of two inch cubes of the same materials and age was 101.5 pounds per square inch. The average modulus of rupture of the blocks was 231 pounds per square inch. About half these blocks failed to crush at the maximum pressure possible on the machine, 880 to 963 pounds per square inch, so that the actual compressive strength is greater than that named.

In vol. xxviii, p. 125, the averages of six blocks show 3,842 pounds strength in cross breaking; compressive strength of prisms cut from blocks averages 1,021 pounds per square inch. Tensile strength of four such prisms averages 224 pounds per square inch. The blocks were made of 1 part cement, 2 sand and 3 broken stone and were 4 months old.

In vol. xxix, tests of half blocks are given, averaging 2,370 pounds per square inch for blocks of 1 cement and 4 sand 9 months old, and 3,060 pounds for blocks of 1 cement, 3 sand and 5 broken stone, 12 months old, the results being per square inch of the area of concrete.

Recent tests at the Case school showed 1,500 to 2,000 pounds per square inch on blocks 10 weeks old, and over 2,500 pounds on those 22 months old, blocks being 6x8x9 inches and one-third hollow.

In vol. xxix, p. 356, the requirements of the Philadelphia building code are given as follows: Modulus of rupture 150 pounds average, none below 100; compressive strength at 28 days 1,000 average, none below 700. The actual results on blocks tested under the specifications are said to have been 150 to 175 pounds per modulus of rupture and 1,200 to 1,600 pounds for compression, the cross-breaking tests being made on the blocks according to instructions and the crushing tests on cubes cut from blocks so as to contain a full web section. The proportions of voids in the blocks are fixed for various conditions, usually at about one-third.

On page 358 of the same volume the requirements for Newark, N. J., are stated as 150 pounds per square inch for tensile strength and 1,500 pounds for compressive strength.

Jersey City, N. J., requires that "the loads on cement or concrete building-block work, including their own weight, shall not be greater than 250 pounds per inch."

New York City requires of all building materials an average modulus of rupture of 450 with no result below 350 and an ultimate compressive strength of 3,000 pounds per square inch, with no result below 2,500. However, the New York, Chicago and Cleveland ordinances are reported by the chief engineer of the department of buildings of New York to require of ordinary concrete not more than 500 pounds working stress on extreme fibre or 350 pounds in direct compression. This variation of requirements shows that there is as yet no body of results of experiment upon which to base proper regulations. The variations in results of tests also show that the effects of proportions of materials, manner of making and compressing blocks and of curing, methods of testing, size of specimens, and methods of securing them, as well as machinery for and methods of testing have not been studied and that the results are, therefore, not of much value, except for blocks made under the same conditions. The results of the tests at St. Louis are awaited with interest, as the points mentioned are given proper consideration in the series there under way.

CURING BLOCKS BY STEAM.

Can cement blocks or brick made by the dry process be cured with steam?

What is the approximate cost of the steaming process?

C. P. C., Walworth, Wis.

Blocks and bricks can be so cured. Reference may be made to articles on this subject in this department in MUNICIPAL ENGINEERING, vol. xxx, p. 18, and p. 200, for some detail as to methods. The cost with high pressure steam is not known, but Mr. Sherer, who is referred to in the latter of the articles mentioned, may be willing to give some idea of his experiences. The extra cost if exhaust steam is used would be very small if the block plant is operated by steam power. It would only be necessary to close the shed in which the green blocks are stored and they could be removed to the curing yard at the end of a day, more safely than if they are stored in a shed according to the usual manner. There might be a little more inconvenience and loss of time or labor in handling blocks due to the closed storage-room. Cars for handling the blocks and for holding them during the time they are in the steam would

be a desirable addition to the ordinary plant, even if they do add somewhat to the expense of installation.

CONCRETE CONSTRUCTIONS ON THE FARM.

We have a particularly good customer who is about to install a piggery on an experimental farm; he purposes putting in cement floors and hollow concrete walls for the piggery. The hollow walls will be 7 feet high. He also intends to construct a concrete tunnel about 1,500 feet long, which will be 6½ feet high by 4 feet wide. If you can give us any cuts or information on this subject, we would appreciate it very much.

S. R. B., Montreal, Can.

The best articles on this subject which the writer has seen are in the booklet of the Atlas Portland Cement Company, 30 Broad street, New York City, on "Concrete Construction About the Home and Farm," and in the special publications of he United States Department of Agriculture, Washington, D. C., on the same subject. The former is specially well illustrated and shows both the constructions named. These publications can all of them be obtained on application to the addresses given.

REINFORCED SIDEWALK BLOCKS.

In response to the inquiry for makers of reinforced sidewalk blocks printed in this department, vol. xxix, p. 349, the St. Louis Expanded Metal Fireproofing Company, Century Building, St. Louis, Mo., sends a pamphlet entitled "Metalloid Sidewalks," which describes and illustrates fully the method of making reinforced sidewalk blocks in factory and laying them in walk. The specifications are as follows:

Foundations.—After the ground has been brought to the proper grade, two trenches parallel to the curb line, 8 inches wide by 9 inches deep, shall be dug, one under either side of the walk. These trenches shall be 5 feet 8 inches between centers for a 6-foot walk and one foot less for a 5-foot walk.

These trenches shall then be filled with cinders, thoroughly tamped, the surface being brought to a grade 4½ inches below the walk surface. The ground between the trenches should nowhere project more than 1½ inches above the surface of these foundations.

Paving Blocks.—The paving blocks shall be constructed as shown on the drawings, with 2-inch projecting lugs along the outer edges on the bottom of the blocks, and with No. 16 gauge 2½-inch mesh expanded metal on the bottom side of the slabs, the long diameter of the mesh being placed at right angles to he curb line.

The concrete in the main slab shall be 2 inches thick and composed of one part Portland cement and five parts of limestone screenings, or one part Portland cement, two parts sand, and five parts of fine, clean cinders. (The latter is the better, as it is fully as strong and much lighter.)

The top surface shall be composed of one part of Portland cement and two parts of sifted granite, ½ inch thick, floated to a smooth finish.

Placing.—The slabs, in transporting, loading and unloading and during placing, shall be kept right side up and always supported at the outer edges where the lugs occur.

After the preparation of the foundations as above described, the slabs are set in place with a space of ⅛ inch at each joint. They must be true to surface and line.

Tests show that the blocks will carry nearly or quite twice as great a load per square foot as the ordinary sidewalks similarly supported and that they will withstand hard usage, such as ordinary teaming over them, with little or no injury.

STRENGTH OF CONCRETE SLABS.

In reference to the review of Taylor and Thompson's "Concrete, Plain and Reinforced," which appeared on page 61 of the January number of MUNICIPAL ENGINEERING, and in which appeared a criticism of the solution of the problem of design of a reinforced concrete slab, Mr. Sanford E. Thompson says:

The point referred to in the review with reference to example 11, page 317, is made clear in the third thousand issue of our book, which has recently been printed. The example in question applies to a slab supported at the ends simply, while the slab tesed by Mr. Condron acted more or less like a flat plate supported on all four sides. Mr. Condron's slab also had a shorter span between supports, 14 feet instead of 16 feet, and was made, I think, with a slightly richer concrete and with high carbon steel. A slab supported at the ends gives, of course, a much lower strength relatively than one supported on four sides, because the weight of the slab is the same in each case, and while the strength of the slab supported at the four sides is at least double, even with very slight cross reinforcement, its safe live load is several times that for the slab supported at the ends. Thus in the solution of example 11, the total safe load is given as 160 pounds, which, deducting the weight of the slab, becomes 57 pounds for the safe live load. If the total safe load is doubled, to provide for the extra support, we have 320 pounds, and, deducting the dead load, which is the same as in the preceding case, gives 217 pounds as the safe live load. Taking account of the difference in the other conditions, this agrees with the units employed in Mr. Condron's design. However, even this is very conservative, and, as you indicate in your review, as soon as thorough tests have been made, we shall probably all consider it wise to increase our loadings.

I make this statement, not because I think it is necessary to correct the review, but simply that you may see that the apparently serious discrepancy in the chapter is due to the manner of stating example 11 rather than to error in theory, and to assure you that this lack of clearness is corrected in the last issue of our

book. We have also inserted two new tables, giving the strength of slabs or panels supported on all four sides.

THE IDEAL CONCRETE BLOCK MADE PRACTICAL.

With much interest nd pleasure I read, in the March issue, the article "The Ideal Concrete Block Made Practical," by Louis H. Gibson. I am interested because it contains valuable information. I hope you may be able to give us more such articles dealing with this, the pretical side of concrete work. I am pleased because I find I am not alone in this line of research. The more I study "cement stone" the more I am convinced it is not a question of "machine," only so far as the machine economizes labor; nor the "style of block," other than economy of material and the appearance. It is not what we mold them in, nor the shape, but of what and how we make them. Mr. Gibson is right, chief among the materials is the aggregate. It appears so unscientific to take such care in selecting the steel and the cement, and testing them for reinforced or plain concrete and then to dump into the equation an indefinite volume of indefinite sand, gravel or crushed rock. The statement in specifications, or of tests made, of a 1-3-5 mixture—meaning one part cement, three parts sand, and five parts gravel — conveys but little more meaning as to the real compound than though the "one part" could be interchangeably Portland cement, natural cement, or lime. For what one calls "sand" another calls "gravel," and vice versa. Has there been any attempt made to standardize the meaning of these terms? It appears nearly every writer considers sand to be just "sand." In my own experience and investigations, I find I dare no more take this definition than that cement is "cement," making no distinction between Portland and natural.

You will do me a great favor if you will, through the magazine, tell me how and where I may obtain a description of the researches and practice of the "bitulithic paving company" Mr. Gibson mentions, also the practice and experience of any others helping me to govern the voids in the aggregate.

The aggregate I use is a river or glacier deposit of granite and quartz "sand and gravel," ranging in size from 1-200 inch to 3 inches. It is deposited in both pockets and strata, ranging in voids from 18 per cent. to 50 per cent. By careful selection I am able, after separating with 1-inch mesh screen, to have an aggregate of not to exceed 22 per cent. voids. Most of the material ⅝ inch and smaller seems to be quite sharp and angular. Most of it above this size is quite round and smooth. When screened through a ½-inch screen, as some advise, the voids are greatly increased and fully one-half of the material is rejected. If I rescreen and regrade to reduce the voids, I will lose still more of my material, as much of the fine will be rejected. This will farther increase the cost of the material used.

Could I not economically use a crusher and reduce the large "gravel" and so make a combination with less voids, more angular aggregate, and be able to use all, or nearly so, of the material as it comes from the bank? So far I have been unable to find a crusher to meet my requirements. They all have too large capacity and require too much power. Large capacity is not required, but rather one that can be operated with the same power as is used to operate the mixer and kindred machinery. It seems to me, a crusher with a capacity of not to exceed a half yard or yard an hour and not taking to exceed six horsepower to operate, would be the ideal one for the blockmaker using "gravel" aggregate. Do you know who makes such a crusher, or am I the only one wanting something of this kind?

H. A. MARK, Mitchell, Neb.

Most of the above questions are referred to our readers for answer. MUNICIPAL ENGINEERING will publish any replies which are sent. The methods of the Warren Brothers Company used in preparing the aggregate for bitulithic pavement are described in several articles in MUNICIPAL ENGINEERING as follows: Vol. xx, p. 262; vol. xxi, p. 40, the specifications in the patent for grading and mixing the broken stone; vol. xxii, p. 185; vol. xxiv, p. 115; vol. xxv, pp. 99 and 325, the article on page 99 having a particularly full description of all steps of the process.

ARCHITECTS WHO RECOMMEND CONCRETE BLOCKS.

We find that our architects, in many cases, are afraid to specify concrete blocks through their ignorance of the strength and durability of the material. We feel that we can open their eyes to the fact of these conditions by referring them to some of your Western architects who are specifying the material extensively.

If you can help us to locate some of their largest buildings, it will be considered a very great favor.

J. & L., Richmond, Va.

Architects who recommend concrete blocks have been named in MUNICIPAL ENGINEERING, such as Louis H. Gibson, Indianapolis, who is writing the series of articles on concrete blocks and concrete block architecture which are now appearing herein, and George D. Mason, Detroit, Mich., who recommended them for a large apartment house. Some photographs of architectural concrete work in Germany will be found in vol. xxviii, p. 296.

Two large buildings are under construction with concrete blocks for the Twin City Railway Company in Minneapolis, using concrete blocks above ground. A concrete block church in Kansas City, Mo., is shown in vol. xxviii, p. 495. A small concrete block bank building in Carbon, Ind., which passed without injury through a fire which destroyed all the surrounding buildings is shown in vol. xxviii, p. 491. Two two-story concrete block factories in Iowa are shown in vol. xxviii, pp. 340 and 341. There are some three-story block factories and storehouses in Waterloo, Iowa. A two-story concrete block factory in Port Chester, N. Y., is shown in vol. xxviii, p. 181, and

a two-story house in Columbus, O., on page 183. A very elaborate house is shown on page 120. There are other houses and churches shown in vol. xxix, one in Stoughton, Wis., on p. 67, one on p. 387, a church in Staunton, Va., on p. 386, an apartment house in Springfield, Mass., on p. 389. The current volume shows a house on page 75 of the Philadelphia Concrete Company, 420 Land Title Building, Philadelphia, Pa., and a three-story house in Washington, D. C., on page 236. The architects of these buildings are not known to the writer. There are now thousands of houses, stores and factory buildings made of concrete blocks. Such firms as the Schatzinger Realty Co., of Cleveland, O., have built perhaps hundreds of handsome structures. Pittsburg, Pa., is another city containing many examples of good buildings in concrete blocks. Letters to the concrete block machine makers mentioned in the "Business Directory" printed in each number of MUNICIPAL ENGINEERING under the headings "Concrete Blocks" and "Concrete Construction Machinery," will bring photographs of other buildings, and upon special inquiry the names of the architects can doubtless be obtained. In this connection the papers before the National Association of Cement Users in the current volume of MUNICIPAL ENGINEERING, on "Causes of Failures in the Concrete Block Business," by O. U. Miracle, p. 109, and "Cement Block Architecture," by L. H. Gibson, p. 112, should be read.

The inquiry for names of architects using concrete blocks is referred to our readers with request that they send us the names of those known to them.

REPAIRS TO CEMENT-LINED WATER MAINS.

Enclosed please find a formula in regard to cementing leaks in iron pipes, from "Popular Mechanics." Now this formula might work with good results on cement-lined water mains.

CHAS. BECKER, Milwaukee, Wis.

The inclosure has the heading "Cement for Closing Leaks in Iron Pipes" and reads as follows:

The following formula is good for this purpose, but must be used as soon as mixed and rammed tightly into the joint or leak:

Five pounds coarsely powdered iron borings, 2 ounces powdered sal ammoniac, 1 ounce sulphur, and enough water to moisten. This cement hardens rapidly. However, the sulphur may be left out and it will set even more firmly, but require a longer time.

Mr. Becker offers this in reply to the question under the same heading as this article on page 133 of the February number. The cement described is one for use with iron and would not be quite as satisfactory for use with cement, because it would not join as closely with the cement edges of the crack or opening in a cement pipe as it would with iron edges. Have any of our readers tried this method of stopping leaks in cement pipes?

WHO MAKES "CROWN JEWEL" AND "ADAMS" LIME?

Can you give us the addresses of the makers of "Crown Jewel" and of "Adams" lime and also any other good brand of lime?

C. & V., Schenectady, N. Y.

MAKER OF IDEAL PORTLAND CEMENT.

Kindly give me the address of the Ideal Portland Cement Company, manufacturers in Colorado.

J. F. G., Ft. Worth, Tex.

The Portland Cement Company, Portland, Col., manufactures the Ideal brand of Portland cement and is doubtless the company referred to. The plant is on the Denver and Rio Grande and Atchison, Topeka and Santa Fe railroads, near Florence, Col.

INFORMATION ABOUT CEMENT BLOCK CONSTRUCTION.

I want to get books on cement block construction and am referred to you. I want to study the question out in theory and practice. We have millions of tons of tailings here from zinc concentrating plants and these tailings (free) make good cement blocks. We also have abundance of limestone rock to add, if necessary, to avoid using too much cement.

H. E. H., Highland, Wis.

The first article to read is the paper by S. B. Newberry, which was presented at the Milwaukee convention of the National Association of Cement Users. Part of this paper is given in this number of MUNICIPAL ENGINEERING. The whole paper can be obtained on application to the secretary of the Association of American Portland Cement Manufacturers, Land Title Building, Philadelphia, Pa. The next books to read are the proceedings of the conventions of the National Association of Cement Users. These can be obtained entire for the first and second conventions by joining the association at a cost of $5. The office of the secretary is 310 Commercial Club Building, Indianapolis, Ind. MUNICIPAL ENGINEERING contains the most important parts of these proceedings and many other articles of great value, including especially a series by Louis H. Gibson, which began in the number for December, 1905, and, while recommended to be read last, are the most important for one who is going through the question thoroughly. This magazine for the last

three or four years shows the development of the cement block industry, and a subscription begun at any time after December, 1901, will be found fruitful.

EXPANSION JOINTS IN BLOCK WALL —PATENTS ON TANK MOLDS.

In making expansion joints in block construction is it necessary to make a perpendicular joint in the wall or would it answer to make the joint zig-zag as the blocks would lay up.

Can a person make molds for watering tanks, and sell the tanks without infringing on any patents? If not, who has got the patents? MARSHALL HILL,
Rochester, Ind.

It should not be necessary to make expansion joints in a block wall. The joints between the blocks are usually flexible enough to take up the slight expansion in the single blocks. But if, for any reason, an expansion joint is thought to be desirable, it can follow the joints between blocks and need not be on a continuous vertical line.

Molds for making watering tanks can certainly be made so that they will not infringe on any patents. The patents are usually on special forms of tank or mold, special appliances for handling molds or tanks, reinforcement, protection, etc. It would be impossible to make a list of patents which might be infringed which would be good for any length of time, so many patents on handling of cement and concrete are issued each month. The lists of patents appearing each month in MUNICIPAL ENGINEERING may be watched for patents which are in the same line.

SEWERAGE AND GARBAGE

Cost of Cleaning Sewers—Breakage of Sewer Pipe—Detroit and Chicago Garbage Problems—Sea Water For Sewer Flushing—Changes In College Engineering Courses.

Cost of Cleaning a Large Brick Sewer.*

By Frederick L. Ford, City Engineer, Hartford, Conn.

During the past season considerable work has been done in cleaning the Franklin-avenue sewer, one of the largest in the Hartford sewerage system, the results of which may interest engineers called upon to estimate on or have charge of similar work. While we do not claim any novelties in the system used for cleaning, we believe we have obtained very satisfactory results.

The sewerage system of Hartford is wholly built on the combined plan, providing for sewage and surface water, and consists at the present time of about 87 miles of main tile and brick sewers, all built since 1844, the date of the first sewer in Hartford. Most of the sewers have sufficient grade to produce self-cleaning velocities, so that the maintenance account of our sewer system is reduced to a minimum.

The Franklin-avenue sewer cleaned consists of 9,269 lineal feet of circular brick sewer, 5,128 feet of which is 6 feet inside diameter, 2,225 feet 4 feet and 1,916 feet 3 feet inside diameter. This sewer was built in 1872-3, at a cost of about $150,000, and drains a district containing about 1,167 acres. It has never been thoroughly cleaned since it was built. The sewers which discharge into this trunk sewer vary from 8 inches to 3 feet in diameter, and have grades ranging from 0.5 to 6.0 feet per hundred. The 6-foot Franklin-avenue sewer has a grade of 2 feet per thousand, and the 4 and 3-foot sections a grade of 3 feet per thousand.

This trunk sewer, although considered entirely too large at the time it was built, is now hardily sufficient to provide for all the water collected during severe storms, and considerable difficulty is experienced by the flooding of cellars and basements adjacent to this large sewer. This condition has come from the rapid growth of the district and the gradual change of a large part of the district from an absorptive to an impervious surface.

On account of the congested condition of this sewer we started some experiments the past season to determine the location and extent of the nuisance, and also to measure the amount of water passing off from this district during severe rain

*A paper before the Connecticut Society of Engineers.

storms. It was during the organization of this work we discovered the serious condition of this sewer. The first work done was a thorough inspection of the sewer to determine the location and amount of the deposits. In the 6-foot sewer this was an easy task with lanterns, and the material was found only in patches on the bottom, averaging from 6 inches to a foot deep and from 50 to 150 feet in length, located usually just below where some large tributary sewer entered the Franklin-avenue sewer.

It was impossible to make a thorough advance inspection of either the 4 or 3-foot sections of the sewer, as the manholes were, as originally built, sometimes 1,000 feet apart, and the ventilation so bad that we found it suffocating and too dangerous to enter either for any great distance from any manhole.

The deposits in the 3-foot sewer were found, upon opening the sewer, to average about 1 foot in depth and the ordinary sewage, about 6 to 8 inches, was running on top of it, so there was little available working space left.

As the magnitude of this work was a very indeterminate quantity, it was decided best to engage a competent sewer contractor to furnish all materials and labor and superintend the cleaning on a 15 per cent. basis. He selected a foreman at $15 per week, and for laborers some trustworthy Italians, who, from their small size and rugged constitutions, were best adapted for this work, and paid them $2 per day, 50 cents more than they ordinarily received on sewer work.

Before commencing the cleaning manholes were built where necessary, so that they are now not more than 300 feet apart and often less on the smaller sizes.

In cleaning, the force was organized in small gangs, which could work to advantage, two starting at a manhole and working in opposite directions until they met the men coming in the opposite direction.

In the 6 and 4-foot sections wheelbarrows were used to convey the material to the nearest manhole, where it was hauled up and removed in carts, each holding 1 cubic yard. In the 3-foot sewer the men used pails to remove the deposit.

The result of the work is as follows:

	Length.	*Loads.*	*Cost.*
Six-foot sewer...	5,128 ft.	107	$387.55
Four-foot sewer..	2,225 ft.	61	243.80
Three-foot sewer.	1,916 ft.	107	466.38
Totals	9,269 ft.	275	$1,097.73

The average cost per load (cubic yard) on 9,269 feet of sewer was $3.99, and the average cost per lineal foot was $0.118.

Size of sewer, ft.....	6	4	3
Cost per load.....	$3.62	$3.99	$4.36
Cost per foot.....	0.075	0.109	0.243

The 6-foot sewer was cleaned in seven days. The total time on this work, including foreman and team, was 1,592 hours. This is equivalent to 22.7 men working ten hours a day for seven days.

The 4-foot sewer was cleaned in four days. The total time was 1,000 hours, equal to twenty-five men employed ten hours a day for four days.

The 3-foot sewer was cleaned in thirteen days. The time occupied was 2,019 hours, or an average of 15.3 men working ten hours a day for thirteen days.

The average distance cleaned by each man per day on the 6-foot sewer was 32 feet, on the 4-foot sewer 33 feet, and on the 3-foot sewer 9 feet.

The total cost of the work, including manholes built, was $1,395.47, of which 15 per cent. was paid to Mr. Charles H. Slocomb, who furnished the labor and materials and superintended the work.

Breakage in Sewer Conduits: Its Cause, Effect and Prevention.*

By Alexander Potter, C. E., New York City.

Data in relation to the extent of broken pipe in sewer trenches are difficult to secure. There are a number of reasons for this. Perhaps the first and most general is ignorance of its existence. Many who wonder why certain lines of pipe leak and cause trouble, even where close personal attention was given to the construction work by the engineer in the hope of securing satisfactory work, would cease to wonder if some of these ditches were opened up and the condition of the pipes exposed.

Again, it is pretty well understood that, barring the admission of ground water, the existence of cracked pipe in a sewer does not affect its use as a water carrier except in quicksand excavation. When fine running sand is encountered, the necessity for tight joints is essential, for it is often cheaper to relay long stretches of pipe than to remove the sand in the pipe after it enters the sewer and packs itself therein. In the larger sizes this admission of quicksand will tend to remove the support from the pipe and cause rupture.

Generally, it is only when the pipe is so badly broken as to require replacement, that information is sought and obtained,—and usually meager information at that, especially as to the cause of breakage. An engineer is naturally not eager to make known the existence of

*A paper before the Sanitary Section of the Boston Society of Civil Engineers.

cracked pipe unless it is liable to cause trouble. As we have little or no published data relating to the extent of broken sewer pipe in constructed sewerage systems, and there is so little known about it, engineers have gone on building pipe sewers under specifications which will, in the opinion of the writer, produce broken pipe in all the larger sizes.

It is safe to say that cracked and broken pipe is general to an extent much greater than people think. More broken pipes exist today in sanitary sewers laid with the utmost precaution and with well-selected pipe than exist in ordinary drains at greater depth laid with inferior pipe.

The use of cement and vitrified pipe on sanitary sewer work is of comparatively recent origin, and much of the knowledge secured concerning its behavior was based on its use in culverts and drains, in which case the admission of water through the joints was a positive advantage in lowering the ground-water plane, and consequently little attention was given to the joints. The admission or imfertmemem joints. The omission or imperfect application of the cementing medium did not impair the strength of the drain. Each pipe assumed its own bearing, practically independent of its neighbor. When, however, care is taken to properly joint the pipe, as is the case in the laying of a sanitary sewerage system, an element of weakness is introduced, due to the inelasticity of a properly jointed line of pipe, and the imperfect nature of the foundation of one pipe can not be lightly considered, as it may, and frequently does, vitally affect the stability of many of its neighbors.

In laying pipe through dry sand, loam or clay free from water, no difficulty should be experienced in securing a good foundation, for the bottom of the ditch can usually be cut out to the approximate shape of the pipe, and a natural foundation is thus afforded. In rock cuts and wet ditches, however, this is impossible, and the natural support of the pipe must be replaced by an artificial one, and the problem confronting the engineer is a most serious one.

It is a safe assumption, and one which is amply borne out in practice, that the presence of ground water in pipe sewer trenches at least doubles the actual cost of sewer construction if the best work is to be secured. In the endeavor to prevent this increase in cost to his clients, the engineer is tempted to take chances. Indeed, this risk, admitted or not, is taken by engineers all over the country, with the result that today there is much defective work buried, like the "doctor's mistakes," under the ground.

A common form of foundation in wet trenches consists of well-rammed gravel, broken stone or cinders, usually with the addition of underdrains. Concrete is also used quite generally. A proper foundation is also secured in yielding material by using timber under the pipe, either in the form of planking, some form of cradle, blocking or piling. The ordinary and usual methods of replacing backfilling material around the pipe are not sufficiently thorough to insure the larger sizes of pipe from cracking or collapse. The statement that it is practically impossible to properly backfill with the material taken from the trench in general, under and around the pipe on the larger sizes where the natural foundation of the pipe has been removed, will not be seriously challenged. Rupured pipe can only be properly avoided by filling the space under the pipe and up to one-third of its height with concrete, which can be very clean, if the pipes are properly jointed, or by filling up to the top of the pipe with fine sand, flooded to enable the sand to flow entirely under and around the pipe, thus insuring a hard foundation. The use of the sand in this way is only practicable where some jointing material which immediately hardens is used.

It is a fact that most specifications have excellently worded clauses about backfilling which are impractical in many ways. In many trenches it is absolutely impossible with any tool to ram the backfilling material below and around the lower portion of the pipe. Again, it is difficult to get workmen to appreciate the importance of thoroughly treating each and every foot of pipe along the line of the sewer with the same faithful care, and it is often impossible for the inspector to watch both pipelaying and backfilling, even when he is inclined to be most watchful. The material at hand for backfilling around the pipe, even when carefully selected, may not be suitable. If these objectionable conditions are not well guarded against, the resultant breaking of one pipe is liable to rupture a hundred.

Another element of uncertainty in sewer-pipe laying is the character of the pipe itself. The writer has often secured better results in standards of vitrified pipe from one manufacturer than from double-strength pipe of another maker, and material from the same factory often varies within wide limits. Whether the pipe be shale, fire-clay, or "stoneware," so called, does not render it immune from breakage under certain conditions. This lack of uniformity in output is equally noticeable in molded cement pipe.

In the construction of the Joint Trunk Sewer in New Jersey, recently completed, 150 miles of sanitary sewers, trunks and

laterals in the municipalities interested, exceptional facilities were afforded the writer to study this question, for over 65 per cent. of all the ditches were dug through drift saturated with water, requiring the disturbance of the natural bed for the pipe.

In constructing a separate system of sewers, the aim of the engineer is to secure water-tight work, but in water-bearing ground nothing is more difficult of attainment. The Joint Sewer work afforded an exceptional opportunity to determine what could be done in wet work. It was observed that if the joints in sewer pipes were properly made, a cylinder of indefinite length was produced, and very slight irregularities in the grade or slight settlements in the foundations greatly reduced the power of the pipe to resist cracking, as the pipe is practically inelastic.

In experiments made by Parkin, and described in the Transactions of the Liverpool, England, Engineering Society, vol. xvii, 15-inch pipe, supported on permanent pillars 8 feet 4 inches apart, broke under a gradually applied load of 2,491 pounds, including the weight of the pipe, and showed a maximum deflection of 1-30 of an inch at the centre. If the trench is backfilled before the jointing material hardens, the sewer will better adjust itself to the irregularities of grade or to settlement in the foundation. This will reduce the liability to rupture, but will increase the percentage of leakage through injury to the joints. The injury to the joints is caused by the raising of the water in the trench, softening the cement and causing it to sag or drop off altogether; or, if the cement has had an initial set before the water is allowed to rise, the pressure of the earth ruptures the joints through settlement, or the cement is broken off by careless backfilling. As a matter of fact, the expression "careless backfilling" is hardly applicable, for to secure even reasonably satisfactory work the highest care must be given to backfilling around the pipe,—greater care, in fact, that can reasonably be expected from the class of men employed upon this sort of work.

From examination of constructed lines of pipe sewers it is almost certain that if a pipe line ruptures at all it will do so at the time of the first heavy rainstorm after the trench has been completely backfilled, provided the frost is out of the ground when the rain occurs.

In the work under discussion 3-foot lengths of pipe were used throughout, and to increase the possibility of securing tight joints, the writer adopted the plan of laying many of the sewers in wet trenches with yielding foundations on cradles. The cradle, or wooden underdrain, as it might be called, consists of four pieces of 2 inch by 4 inch timber laid flat, 6-inch centers, and 9 or 12 feet long. On these were nailed 4 inch by 4 inch 1.5-foot centers. The pipe, held by wedges nailed in position, rested on the 4 inch by 4 inch timbers. The space below the pipe acted as a channel to drain the water in the trench to a sump, and prevented its rising on the joints. This construction is cheaper than the ordinary form of broken stone or gravel foundation with tile underdrain. A questionable feature of this construction, however, is that it leaves a greater area under the pipe to be backfilled, and in clay or other compressible soils this is objectionable. Imperfect backfilling under and around the pipe is the principal cause of failure in sewer pipe.

On the construction of the work referred to, on the larger sizes, all the pipe laid one day was inspected before starting work the next day, and, if found to be satisfactory, passed upon. When the work was about half completed the writer made a personal examination, and himself crawled bodily through several sections of the 24-inch sewers in deep cuts and other parts where there was a possibility of breakage, and, finding some broken pipe, notified the contractor. The contractor, at a loss to explain its existence, attributed the breaks, which were not many, to the use of the timber supports, and requested permission to use the old form of tile underdrain and broken stone or gravel foundation on the work from that time. This permission was granted. The contractor, desirous of throwing the responsibility of the former breaks upon the method of pipe laying previously used, took more than ordinary care with the work as it then proceeded, including the jointing of the pipe with cement. The joints were in consequence practically perfect, but the ditch was not refilled until the joints had had twenty-four hours' set. The gravel was then thoroughly rammed under and well up around the pipes. In fact, no more perfect work could have been performed. The depth of the trench at this point ran from 6 to 8 feet, and standard thickness of pipe was being used. When 200 feet of this work had been laid and the backfilling completed, an examination of it was made and it was found to be broken almost from end to end, and actually collapsed at two points. Had the ditch been refilled before the cement hardened the liability to rupture would have been lessened.

A systematic inspection of all completed sections was then started and all

cracked pipe either replaced or surrounded with concrete. On all sewers 20 inches in diameter and over, an assistant engineer crawled through every length of pipe laid. On sewers of smaller diameter, an examination was made with the aid of mirrors. In some detail the record of breaks was as follows:

On 26,303 feet of 24-inch pipe, most of which was standard thickness, 24 different breaks occurred on 24-inch pipe, aggregating 1,500 feet, each break running from 15 feet to 150 feet. Nearly all of the breaks occurred either in gravel or rock cuttings. No breaks were found in quicksand. The proportion of breakage on gravel or broken stone foundation with underdrain to the total length of sewer laid with this class of foundation was much greater than the proportion of breakage on timber foundation to the total length of sewer laid on this latter class of foundation. The depths of cuts where breaks occurred varied from 6 feet to 20 feet, but more broken pipes were found at the lesser depths.

On 8,197 feet of 22-inch standard pipe, at depths varying from 6 feet to 20 feet, much of which was laid on timber foundation and none on gravel or broken stone, not a single cracked pipe was found.

Fourteen breaks occurred on 4,382 feet of 20-inch pipe, aggregating 500 feet in all. All of these breaks occurred in rock cuttings where the pipe was temporarily supported on blocks until selected material was rammed solidly around and under the pipe. A close inspection of the uncovering of the pipe revealed the fact that at certain places sufficient space had not been left at the springing line of the pipe to allow room for the proper ramming of the backfilling around the lower half of the pipe.

On the short stretch of 18-inch pipe laid on a heavy grade, the sewer collapsed shortly after construction, due to the flood of water washing out the newly filled-in material over the sewer under the macadam pavement, which dropped on the pipe and ruptured it.

Concreting under all pipe in wet trenches on this work would have added $125,000 to the cost of the sewers, which was $1,680,000 for 145 miles of sewers. The total cost of replacing the broken pipe was less than $5,000. This did not stop all leakage, but the actual amount of leakage on the entire system was less than 15 per cent. of the capacity. Had concrete been generally used and the same care given in jointing the pipe, the leakage could have been reduced fully 50 per cent. The value of the additional capacity thus secured for sewage purposes would have been $148,170. In designing the sewer, the provision was made for ground water infiltration of 33 per cent. of the capacity. This is not an unusual allowance.

When laboratory experiments show in some cases a leakage in a 6-inch pipe, laid with ordinary care, at the rate of as much as 50,000 gallons per mile a day, is it any wonder, with the additional liability of leakage through cracked pipe, that at least one case is recorded where the leakage in a system with a 24-inch main sewer is only limited by the size of the sewer itself? The writer refers to the "town in New York State," not named, given in a list of towns where records of leakage were obtainable, in an article read by Prof. A. P. Folwell before the American Society of Municipal Improvement a few years ago.

A number of observations in pipe sewers laid under similar conditions have been made to determine the relation between the rate of leakage and the size of the sewer, and while such a relation is hard to establish, the writer's observations so far warrant the conclusion that in general in pipe sewers it varies directly as the square of the diameter of the sewer. This is an important consideration in the design of a sewerage system where large provision is made for groundwater filtration, for in thus increasing the size of the conduit we introduce a factor that calls for a still greater increase in size.

The writer is free to confess that he is not able to account in each case for the cause of the breakage. For instance, on one stretch of 2,000 feet of 24-inch pipe, not a single piece of cracked pipe was discovered, while next to it, under exactly the same conditions, but laid under another inspector, 800 feet of pipe was broken nearly its entire length. I have no reason to think that one inspector was less efficient than the other. At the last mentioned point, in part consideration of the right of way, we were obliged to replace an open ditch about 300 feet long with a 24-inch drain. For this work rejected pipe from the sewer construction was used almost exclusively, omitting cement in the joints. This drain has been down two years and has not developed a single crack.

In the experience of the writer in replacing sewer lines which have outgrown their capacity, more unexplainable breakage has been discovered on cement sewers than on vitrified pipe sewers.

Much information about broken pipe in systems throughout the country has come to the writer through reliable sources, the truth of which there is no reason to doubt, but which I think it unnecessary

and hardly proper to refer specifically, as it is not my own work. It is to be hoped, however, that other engineers will be frank enough to contribute of their experience, so that as far as possible facts may be obtained and the proper use of sewer pipe standardized.

If the writer is credibly informed, a large city in the middle West, favorably situated for the use of sewer pipe, has recently abandoned its use on all sizes over 18 inches because of the condition in which some lines of pipe already laid have been found.

It is vitally important to engineering that such a case should be recorded and the facts given in detail.

To what extent, if any, breakage is attributable to the use of 3-foot lengths might form a basis of inquiry. A reduction of 33 per cent. of the number of joints is always a sufficient warrant for the use of 3-foot over 2-foot lengths of pipe, if there is no other offset save the small increase in cost. As 80 per cent. of the breakage on the work referred to occurred in ditches less than 10 feet deep, the use of standard pipe on much of this work can not account for the failure of the pipe.

The writer is of the opinion that the larger sizes of vitrified pipe should not be used in sanitary sewer construction, say on 20-inch and over, except upon a concrete base, and the relative cost of other material should be compared upon this assumption.

On smaller sizes than 20-inch, concrete should be used under the vitrified pipe far more generally than it is at present, and if the contractor knows that the use of concrete is to be general throughout the work, the increase in his price will not be excessive.

Engineers engaged in sewer construction have assumed risks in the past for the sake of keeping down the costs on sewer construction, which oftentimes, at best, on account of the great uncertainties in connection with this class of work, exceed their estimates. When broken pipe result they are not relieved from criticism even when the repairs can be effected on a tithe of what it would cost to adopt a method of construction that would eliminate all chance of breakage or when the breakage is the result of careless inspection over which the engineer may or may not have full control.

The writer trusts that the facts set forth and the opinions advanced in this paper, while not new, will call forth a general discussion and criticism from both engineers and contractors. Unquestionably much-needed and valuable knowledge upon this subject may thus be secured.

Detroit's Garbage Question Undecided.

Until the Supreme Court passes upon the decision of Judge Hosmer, in which he refuses to mandamus the controller to sign the contract with the Detroit Reduction Company, the question of the disposal of Detroit's garbage after June 30 will remain undecided. The necessity of prompt action, no matter which concern is to have the contract, is urged by the Detroit Sanitary Works.

Chicago's Garbage Problem Postponed.

Chicago's finance committee decided March 12 that if a garbage contract should be awarded at this time for the disposition of the garbage, a plant could not be built until next September, and that the new system would not be in practical operation until the close of the year. It is not probable, therefore, that the garbage problem will be settled this year. The question of municipal stable and the city ownership of the garbage teams will go over until 1907.

Sea Water For Sewer Flushing.

In his report for the year 1905 Dr. F. L. Frost, who has just retired as health officer of the city of Charleston, S. C., reviews the work of the department, setting forth some emphatic views on hygiene and sanitation, and discussing in full the water supply of that city. He advocates the use of sea water for flushing purposes, saying:

If we can drive water from Goose creek, fifteen miles distant, perpendicularly into the tops of the highest houses in the city, why is it that we cannot drive water from the Atlantic ocean, right at our doors, horizontally through the drains of the city at all hours of the twenty-four, at such force as to drive everything out of the drains throughout the entire length and breadth of the city into the ocean?

Changes in College Engineering Courses.

The State University of Washington, at Seattle, is considering the addition of a second course in engineering, five years in length. This course is intended for students from small high schools which do not have the advantages of those on the accredited list.

A change in the course of civil engineering at the State College at Ames, Iowa, is contemplated. The proposed plan provides for the continuance of railroad engineering work in the senior year, or a choice may be had of structural or sanitary engineering.

STREET PAVING AND CLEANING

Street Cleaning in Baltimore—Bitulithic in Chicago—Macadam For Heavy Traffic—Track Paving in Trenton—Brick Makers' Conspiracy—Shade Trees—Brick Industries—Public Improvements in Manhattan—Some Experiments on Making Roads Dustless—Pavements of Syracuse, N.Y.—Paving Brick and Pavements—Asphalt Block Specifications—Paving Country Roads.

Street Cleaning in Baltimore.

By W. S. Crandall, New York City.

While the city of Baltimore is perhaps the worst-paved city of its size in the country, yet the streets are thoroughly cleaned, and the general aspect of the city is one of cleanliness. This will even impress the casual observer as, compared with the conditions in New York, Chicago, Philadelphia, Boston and St. Louis, the streets are very much cleaner. The present commissioner, Col. J. L. Wickes, is evidently the right man in the right place. With an inadequate appropriation he has achieved most satisfactory results.

While the great fire is a thing of the past, the clever way in which he handled the immense amount of debris resulting from the fire is still fresh in the minds of his fellow citizens. It was undoubtedly a great feat of engineering, and the city was cleaned up at a minimum expenditure. Owing to the large amount of construction work going on within the city in upbuilding the burnt district, the aggregate amount of dirt and refuse removed during the past year was above the normal. There were more than a million cubic yards of ashes, refuse, street dirt, sand, snow and ice collected and removed. Adding the number of cubic yards of garbage, etc., will bring the total number of cubic yards of all kinds of matter from the city to 1,205,725. These figures mean nothing to the average person, who cannot comprehend what the cubic yards mean, but if set up end to end this would make a line three feet wide and three feet high 685 miles long, which statement can better be understood.

The garbage, ashes and miscellaneous refuse of the city of Baltimore are collected and disposed of in a sanitary manner by the Baltimore Sanitary Contracting Co. This work is done by contract and cost the city $198,800 last year. This work cost the city per load in 1904 82 cents, which was reduced to 68 cents per load in 1905. In 1904 it cost the city $0.218 per load for the removal of snow and ice, while in 1905 it cost $0.208 per load.

There are ten horse street sweepers kept busy for an average of ten hours a day seven nights in the week. This means that certain streets are swept every night and certain others two and three times a week. The sweeper used is known as the Hvass machine and has been used for a number of years. There are 177 men employed in the department as sweepers and scrapers and 113 street carts. These carts, with the horses and men, cost the city $3 per day. Each man furnishes his own horse and cart. The total expenditure for running the department in 1905 was $488,305.39.

Bitulithic Ordinance Sustained in Chicago.

In a decision handed down March 9 in the County Court at Chicago Judge Carter upheld the right of the City Council to order Woodlawn avenue paved with bitulithic pavement and overruled the objections made by property owners to awarding the contracts to the Warren Brothers Company, of Boston. Judge Carter's ruling was given in accordance with one in a similar case, some time ago, regarding the paving of certain streets in Evanston. Argument was presented to show that the contract tended to assist in a monopoly, the Warren Brothers Company being the only one which manufactures the pavement, which is patented. Judge Carter, who expects his ruling to be reviewed by the Supreme Court, said he would abide by his former decision, overrule the objections and let the Supreme Court decide.

The history of the case shows that an ordinance was passed by the City Council ordering bitulithic pavement, and when the city applied to the court for confirma-

tion of the assessment objections were made by two property owners in separate suits. One objection was on the ground that the pavement was patented, and no testimony was taken, as this is simply a question of law. The court said that the city had the right to introduce testimony that only the methods of manufacture of the surface are patented, not the whole pavement, and decision was deferred. The other objection was made, first, on the same ground; second, that other pavements approximate the bitulithic in methods and materials and are just as good, and, third, that a patent on a part of the pavement affected the price, virtually controlling the whole pavement. The decision asserted, first, that a patented pavement can be named in a paving ordinance; second, that the evidence showed no pavements that were equal to bitulithic except four approximations thereto, which are now in litigation on claims of infringement of the Warren patents in whole or in part, and that samples and testimony of experts showed that even these are not equal to bitulithic because not so dense, as containing more voids and so not so capable of withstanding weather and traffic; and, third, that when the surface mixture is sold alike to all contractors and is so specified it is in the same category as a definitely named paving brick or a fixed quality of brick. There were no allegations of fraud or of rebates to licensees.

Macadam Not Good For Heavy Traffic.

Opinions of the individual members of the Board of Awards, at Baltimore, Md., indicate that the Annex will not be generally paved with macadam. They are, without exception, opposed to macadam on any street on which the traffic is heavy or on which there are railroad tracks, and the prevailing opinion is that only streets which are used for pleasure driving or for light business traffic should be paved with macadam. Andrew I. Wright, city councilman, is in receipt of a letter from Otis F. Clapp, city engineer of Providence, R. I., regarding macadam paving in that city, in which he says:

We find that we can not make a mecadam stand where very heavy traffic comes upon it. We have several lines of streets leading out to neighboring towns upon which a great variety of traffic comes and goes, from light to the heaviest, and we have to resurface every year at points where intersecting streets cause a concentration of travel, and every two or three years where the street is wider and travel is not so concentrated. Of course, all this varies with the kind of rock used. Some of the best stone we use comes from Connecticut. We have no macadam on business streets within a mile of the center of the city; it doesn't pay.

Trenton (N. J.) Street Railway Company Must Pave Tracks.

The Supreme Court of New Jersey decided in favor of the city of Trenton February 25 in a suit for about $40,000 against the Trenton Street Railway Company for the paving of the streets between the company's tracks. The company claimed that the Voorhees franchise tax act relieves the company from all other imposts and that the requirement to pave, which is part of the franchise contract, is in reality an additional tax. The Supreme Court decided in favor of the city.

Indictments of Brickmakers For Conspiracy Quashed.

Judge Hayden sustained the motion to quash the indictments against the members of the alleged brick combine operating in the city of Akron, O., March 16. The indictments against the brick manufacturers charged that they had entered into a conspiracy some time in May, 1903, and have continuously engaged in a conspiracy restraining trade in brick in that locality up to the time of finding the indictment against them last January. The defendants filed a motion to quash the indictments, setting up a number of reasons, chief of which was the fact that the statutes provide that in returning an indictment under the Valentine trust law it must charge the specific date upon which the alleged violation was made. The court held that as the indictments charged a continuous violation of the act, without giving a specific date, the charges could not be prosecuted under the indictments. After sustaining the motion the court placed each of the brick men under bond for his appearance at the next term of court.

Prizes for Selling Street Shade Trees.

A citizen of St. Louis, Mo., has offered prizes to the amount of $500 to the pupils in the public schools who will secure the largest number of orders for shade trees, to be planted in the city according to plans and specifications prepared by a committee. The first prize consists of $200, and the other prizes are $100, $75, $50, and several prizes of $10. The offer is made through the Civic Improvement League of that city.

Public Improvements in Manhattan.

The miles of streets paved since January 1, 1891, was:

Manhattan	234
Bronx	112

The cost of various kinds of pavement was:

	Manhattan. 1891.	Manhattan. 1905.	Bronx. 1891.	Bronx. 1905.
Granite, sq. yd.	$2.34	$2.20	$2.25	$2.44
Concrete, cu. yd.	4.50	2.80	...	...
Granite on sand, sq. yd.	2.30	...	2.25	1.94
Asphalt on stone, sq. yd.	3.58	1.15	...	1.18
Asphalt on concrete, sq. yd.	4.51	2.00	...	...
Block asphalt	...	...	...	1.52
Ordinary macadam	...	...	...	.90
Telford macadam	...	...	...	1.25

The price in 1891 on asphalt pavement included a fifteen-year guarantee, while the price in 1905 covered a five-year guarantee.

As to electric arc lamps the numbers, kinds and prices are as follows:

IN THE BOROUGH OF MANHATTAN.

Candle Power	Watts	No. of Lamps	Price per Year
2000	450	2850	$146.00
Twin arc lamps 900, each	250 each	206 double lamps or 412 single lamps,	182.50
900	250 single lamps	24	102.20

N THE BOROUGH OF THE BRONX.

2000	450	1399	$146.00
1200 alternating current	400	653	125.00

IN THE BOROUGH OF BROOKLYN.

1200	325	4115	$124.10
1200	325	583	97.50
	(These being under contract)		
1200	355	66	116.80
600	225	210	62.05

IN THE BOROUGH OF QUEENS.

1200 alternating current	400	1898	$124.10
1200 alternating current	400	225	97.50
	(These being under contract)		

IN THE BOROUGH OF RICHMOND.

1200	325	568	$125.00

In 1890 the record for the boroughs of Manhattan and the Bronx show there were 881 electric lamps then in use, the cost of which was as follows:

Lamps.	Price per year.
28	$ 83.95
18	87.60
109	91.25
54	105.85
584	127.75
69	164.25
19	182.50

There is no municipal plant for the destruction of garbage. The city's garbage is handled by a private corporation known as The Sanitary Utilization Company, whose headquarters are at 52 Ninth street, Brooklyn Borough. Light waste, such as paper, wood and similar refuse, is destroyed in an incinerator which provides the light for illuminating one of the street cleaning department stables.

Since 1890 there has been approximately 72 miles of sewers constructed in Manhattan Borough and 201 miles in the borough of the Bronx. The approximate cost of constructing sewers in Manhattan Borough since 1891 was $3,600,000; in the Bronx it was $7,047,256.

There is a plant for the purification of sewage in operation in the borough of Brooklyn and is known as the Powers process.

Since 1890 there were approximately 612 miles of water mains laid at a cost of $4,200,000.

There is at Baisley's and Springfield Ponds on Long Island, which partly supplies the borough of Brooklyn with water for domestic purposes, a process known as the American Filtration plant. This is the only filtering arrangement in public use for the city.

The underground conduits for carrying electric wires are owned by private corporations.

The Brick Industries in 1905.

In reviewing the progress made by the clay-working industries in 1905, Mr. Jefferson Middleton, of the United States Geological Survey, notes that the year was unusually prosperous. There has never been greater activity in building.

In nearly every large city in the United States the demand for structural material, especially brick, was greater than the supply. In Greater New York the enormous consumption of brick drove the price up to $10 a thousand for common brick during the height of the season. What this means will be better understood when it is stated that only a few years ago brick of the same grade sold for less than half this price. Other great cities also consumed unusually large amounts of building brick, though strikes in some of them, notably the teamsters' strike in Chicago, interfered to some extent with the building trades. As a result of the immense consumption of brick in New York, the output of brick along the Hudson River, in both New York and New Jersey, was the largest ever recorded. The same stimulus was felt in points in Connecticut and Massachusetts, as well as at points in New Jersey some distance from the Hudson River.

During the year the paving brick industry was in a flourishing condition, and returns will show a notable increase over the business of 1904. Brick pavement seems to be growing more popular in the smaller cities, and as the proper method of laying it is better understood there is no reason why it should not prove ento be increasing. This kind of brick is tirely satisfactory.

The use of face or front brick seems used now instead of stone on many of the largest buildings.

The output of firebrick naturally reflects the condition of the iron and steel industries, and as these were phenomenally prosperous in 1905, it may be expected that the production of firebrick in that year will show a large increase over that of 1904.

Some Experiments on Making Roads Dustless.

The following is taken from a paper by A. Lyle Rathbone before an English association of automobilists, and describes some experiments which have been made in Liverpool, England, in making macadam roads and paved streets dustless, and one experiment in making a concrete-block street:

The experiments that have been made in Liverpool during the past three or four years with a view of abating the nuisance caused by dust may be divided into two heads—those of a purely temporary and those of a more or less permanent character. Under the first head I would include the covering of the existing surface of the road with some class of oil. Under the second head might be included the renewing of the surface of the road with some form of macadam or broken stone securely amalgamated together with cement, tar or other adhesive material. I propose, therefore, to take the two classes of treatment separately.

The experiments coming under the first head were begun in the year 1902, when the following roads were dealt with: Prescot road, Derby lane, St. Oswald street, Rathbone road and Edge lane, and the materials experimented with were as follows:

Creosote oil (hot).
Creosote oil (cold).
Creosote oil mixed with small proportion of pitch.
Creosote oil mixed with small proportion of pitch resin.
Creosote oil mixed with small proportion of tallow.
Coal tar (hot).
Cheap waste oil, from coal tar.
Common petroleum.
Crude Texas petroleum.

The first experiments were made by sprinkling the surface of the road from an ordinary watering can, and it was found that one gallon would successfully cover an area of 8 square yards. The cost varied from ½ cent to 1 cent per square yard.

It was also found that the oil took a considerable time to soak into the road surface, and accordingly one side of the road at a time was sprinkled, the other side being left, so that rubber-tired vehicles need not pass over the newly oiled surface. Taken as a whole, the experiments were fairly scucessful, although there were some complaints as to the smell of the creosote oil, and also the injury to rubber tires and coach varnish. The experiments also show that the oiling was a satisfactory method of laying the dust; it tended to preserve the surface of the road, less wear took place, the roads dried more quickly after rain, the disintegration to he surface was not so marked nad the noise of the traffic was somewhat diminished. It is rather difficult to decide which of the various classes of the materials would give the most successful result, as the weather during the experiments was, on the whole, very unfavorable, owing to constant rain. The water carts were out for four days only on the adjoining macadam roads. The surface coated with creosote oil mixed with resin gave the cleanest and nicest appearance, while the surface coated with ordinary petroleum was the least lasting, next in order being mixtures of creosote oil with tallow and the hot creosote oil.

The heavy coal-tar waste oil lasted rather longer than the creosote oil and was very much cheaper. In all cases the sweeping labor was reduced, compared with corresponding areas, which were treated only with water. For example, on 5,500 yards the labor was reduced from a total of seven days to one of four days, while the material removed from the surface was reduced from fourteen to five loads, the total reduction in cleansing and watering being 2-3 to ½ cent per square yard over a period of twenty-one days. The first sprinkling kept the surface in good order for about three weeks; the second coat, however, had not entirely disappeared after having been down for nearly five weeks.

In the following year, 1903, experiments were carried out on two important macadam roads in Liverpool, which required a considerable amount of watering. The method of applying the oil was somewhat different to that used in the previous year; the oil was applied by means of syringes with fine roses, the coating being renewed at intervals of about three weeks. As a result the surface of the roadway was kept in better condition than if watering had been adopted. The area experimented on was 12,800 square yards, and the cost works out at 0.025 cent per single sprinkling, which kept the road free from dust for a period of three weeks. As compared with treating these roads with water it was found necessary to sprinkle them three times a day, and the cost of this for a period of three weeks amounted to 0.037 cent per yard. This, as compared with the oil, leaves an ample margin for wet days, when no watering was required. As in the previous year, it was found that there was a considerable reduction in the cost and quantity of the materials which had to be moved in cleansing operations, but no special record of these has been kept. Experiments were also made in oiling the wood pavement on one of the principal carriage roads in the city. In this case, however, the results were not so good, as although the dust was kept down very satisfactorily, which could not be done by watering

even four times per day, the surface became very slippery in showery weather, and graveling was necessary.

During the summer of 1904 further experiments were undertaken, the materials employed being "Westrumite" (applied with a water cart), a composition manufactured by Messrs. Clare & Co., of Liverpool, another composition manufactured by the same firm called "crystallized creosote," "pyne oiline" and calcium chloride. With regard to the experiment made with "Westrumite," that was tried on several of the stone-block streets, but it was found that it was impossible to put on enough of the mixture to keep down the dust without making the sets slipppery. The effect on this pavement was also of a very temporary nature. The crystallized creosote and the "pyne oiline" were not satisfactory, owing to the cost, which was considerably higher than that of watering.

The wood pavement in Croxteth road was also treated with the "Westrumite" preparation, the first sprinkling being with the 10 per cent. solution, and a day or two later with a further 5 per cent. solution. It was found effective for only about eighteen days, whereas, to compare favorably with street watering, it should have stood thirty-three days. It was also tried on macadam roads, but it was found that the cost of the mixture was against it, and in such streets as Hardman street and Belvidere road it would be necessary for the "Westrumite" to keep down the dust for a period of three weeks, but it was found to be effective for a period of only twelve days. Of all these materials Messrs. Clare & Co.'s mixture and the calcium chloride appeared to give the most promising results, and are worthy of further trials on a larger scale. Considering these experiments as a whole, the result would seem to point to eventual success with the use of some classes of oil in the place of water on macadam roads. As yet, however, the experiments have not been conducted on a sufficiently large scale to enable one to come to any definite conclusion, as in many cases a considerable amount of mud and dust would be brought on to or blown on to the treated surface from side streets or other portions of the main road which were not so treated.

Coming now to the second class—namely, those of a more or less permanent character. In this case the object aimed at is two-fold; firstly, to keep down dust and, secondly, to provide an impervious pavement which can be laid at a reasonable price, is easy to wash and is especially suitable in the streets of the poorer parts of the city, where the street is the only playground for children.

Mr. Rathbone here described tar macadam and asphalt pavements.

The concrete macadam blocks are made in molds. The method of manufacture consists in packing large-sized macadam stones, spaced as nearly as possible ⅝ inch apart, in the molds; the interstices are then filled in with a concrete composed of two parts of finely crushed granite to one of cement, and the top of the mold, which really forms the bottom of the block, is filled with destructor-clinker concrete mixed in the ratio of 4 to 1. The surface on which the blocks are molded is faced with brown paper, in order to leave the working surface of the stones free from cement as much as possible, so as to obtain a non-slippery roadway. The bricks are laid on a bedding of concrete in courses across the street, breaking bond as in brick work, the joints being run in with Portland cement grout; and the street can be opened for traffic in a few days. The cost of the blocks laid complete on concrete amounted to $1.35 per square yard, and I anticipate that this will be considerably reduced in order to test this form of paving very severely, with the object of quickly arriving at the probable life of these blocks, so that a fair idea can be got of the expense of maintaining the pavements in the future, as the result of greater experience. The experimental areas have been laid in several of our streets, the largest of which was in Dorothy street. It has also been tried successfully on ordinary street crossings. A further experiment will be tried on the line of docks, to determine the lasting qualities under ordinary traffic.

A cheap surface treatment has been tried on macadam roads by coating them during dry weather with hot tar stiffened with pitch, covering off with clean, dry chippings. This has been found to last about nine months in good order, and costs about 2 to 2⅝ cents per square yard. The compositions which I have dealt with under this second head appear to me to be more suitable, with the possible exception of the "tar asphalt" paving, for town work, as their comparatively high cost would make them beyond the means of most country districts; and I think we must probably look, at any rate for the present, outside large towns to either the "tar asphalt" or to some method of treating ordinary macadam roads with oil, or a mixture of oil and tar.

Pavements of Syracuse, N. Y.

The following table will show the miles of brick and asphalt pavements laid in Syracuse beginning with 1900:

	Brick.	*Asphalt.*
1900	.24	.55
1901	.52	2.60
1902	1.85	.45
1903	3.97	1.09
1904	1.66	1.24
1905	3.81	.90
Total	12.05	6.83

Up to the beginning of 1905 Syracuse had 280 miles of streets, of which 50.62 miles were paved with the following kinds of pavements: Asphalt, 29.92; brick, 15.39; stone, 1.71; asphaltina, 3.60. The estimated total cost of the pavements laid in 1905 was: Brick, $215,480.95; asphalt, $49,480.29; total, $264,961.24.

The cost of some of the brick pavements is itemized as follows: Wolf street, 4,922.33 lineal feet long, cost $49,578.95; West Fayette street, paved with Nelsonville block, 1,204 feet long, cost $14,300; West Fayette and Syracuse streets, 1,884.47 feet long, cost $22,500; Gifford street, vitrified brick and S. S. block, 752.50 feet, cost $10,400.

The pavement of East Fayette street was laid in 1892 and extends from South State to South Crouse avenue, Syracuse

brick being used. It contains 11,126.26 square yards and cost $1.7325 per square yard.

The South Salina street pavement extends from Onondaga to Cortland avenue. Syracuse brick were used and the pavement was laid in 1891 and contains 12,528.49 square yards, costing $2.07 per square yard.

South West street was paved in 1892 with Syracuse brick. It extends from the railroad tracks to West Onondaga street. It contains 12,261.63 square yards of brick and cost $2.25 per square yard.

The asphalt pavement on West Genesee street extends from North Salina street to North West street and was laid in 1890 of Pitch Lake asphalt. It contains 11,009.32 square yards and cost $2.70 per square yard.

In 1900 the repairs to asphalt pavements cost $329.99; in 1901 there is no record. In 1902 they were $2,656.40. In 1903 the asphalt repairs cost $4,586.46. Nothing was spent on brick pavement repairs for these four years, the mileage being small. In 1904 the repairs on 29.92 miles of asphalt pavement cost $9,628.39, and the repairs on 15.39 miles of brick cost $120.73.

Paving Brick and Pavements.

By W. H. Brecht, Des Moines, Ia.

Following are some extracts from a paper before the Iowa Brick Manufacturers' Association regarding reasons for lack of appreciation of the value of brick as a paving material and suggestions as to methods of procedure to improve the situation:

Through the National Brick Manufacturers' Association, and more especially through the efforts of the individual manufacturers, the standard of paving brick is nearly all that can be desired. I know from a limited experience, however, that the making of paving brick is a difficult matter, requiring not only the proper raw materials and the proper methods and processes of mixing and burning, but a scientific and practical knowledge of the business in general. The first paving brick laid in this city were necessarily rather poor in quality, but the product has steadily improved until now it can safely be said that our Des Moines paving-brick manufacturers produce a brick equal in quality to any produced in this country. It is true, and it must be conceded, that the manufacture of paving brick has reached a higher degree of perfection than any other part connected with the construction of a brick pavement. Brick, as a paving material, has received some criticisms because of the inferior quality of the material that has sometimes been sent out by the manufacturers, and there will always be need to exercise care in selecting brick of uniform quality, but I believe that the manufacturers are awake to the situation and that this need will grow less year after year.

Brick's only real competitor in Iowa is asphalt, and when a street is to be paved as a general rule petitions are circulated among the property holders by the advocates of both materials.

In a paper on paving, read before this association by Mr. John B. Gorrisk, of this city, at the 1903 convention, the methods employed by the competitors in promoting paving and circulating petitions were fully and, I believe, correctly explained. If the same methods were and could be employed by the advocates of brick, I firmly believe that the minority petitions would be much less. When a petition is presented to a council, whether it be a majority or minority petition, I should first consider carefully the material best adapted for economy and general utility. It must select a material of sufficient strength and durability for the local needs and take careful thought of the first cost as well as the cost of cleaning, and especially the item of repairing, which, after the guarantee period expires, falls upon the city. Inasmuch as petitions are not generally circulated by the property holders, but by an agent in the employ of some paving concern, for the benefit of that concern, I do not believe in letting the people alone make the selection. Officials are chosen because of their fitness to properly administer the affairs of a city, and I do not believe that the general public is as capable of judging the economy of an improvement as are these officials, who devote their time and study to these matters. This would, however, be not only a poor, but a vicious policy in cities where the officials forget their positions are not to be used for private gain, as is sometimes the case.

A brick pavement constructed in accordance with the specifications adopted by the National Brick Manufacturers' Association will last for twenty-five years or longer. If it does not, there is something wrong in the construction. This is the question that is worrying engineers today, not the question of getting good brick; for, through the individual efforts of the manufacturers, good brick can be secured in almost every locality at a reasonable figure.

Brick pavements have sometimes been brought into disrepute on account of the contractor's failure to comply with the specifications. This occurs where contracts are let to irresponsible parties,

which is often the case. Our efforts to educate the public as to the best and most economical pavement that can be constructed must not be interfered with, and it might be a good idea for the manufacturers to protect themselves by refusing to sell their brick to contractors who do poor work. We recognize the fact that the use of our most excellent material has not expanded in the same way as the use of other materials, and I believe that the poor work done by some contractors is one of the causes.

I might mention here one bad characteristic of some city officials, and that is an inclination to cut the price of brick pavement to the lowest possible figure, and more especially the awarding of contracts to the lowest bidder, whether he be an experienced and reliable contractor or not. It must not be forgotten that the contractor has to pay living wages, and he must have a fair profit, and if the price bid is below a reasonable point he will, without regard to the specifications, make good the loss in some other way.

Let me say in conclusion that brick pavements, if properly presented, will win against all competitors, and if members of this association will be more active in their efforts to educate and agitate for brick roads in the future than they have been in the past the demand for brick pavements will be materially increased.

Asphalt Block Specifications.

The city of Syracuse, N. Y., has adopted the following specifications for asphalt block pavement:

The sizes of the blocks used must be 5 inches wide, 3 inches deep and 12 inches long, and a variation of ¼ inch from these dimensions will be sufficient ground for the rejection of any blocks. The blocks must be composed of crushed trap rock, pulverized carbonate of lime and asphalt cement, mixed in the following proportions by weight, and no change from such proportions shall be made without the permission of the negineer:

Asphaltic cement..... 6 to 11 parts
Crushed trap rock.....89 to 74 parts
Pulverized carbonate of lime. 5 to 15 parts

The blocks furnished shall be subject to the approval of the engineer, and shall withstand such tests for specific gravity, abrasion, tensile and crushing strength as he may prescribe. Whatever the character of the asphalt used, the block shall yield, when extracted with bi-sulphide of carbon and after the evaporation of the solvent, not less than 5½ nor more than 7½ per cent. of bituminous matter, except when other percentages are especially permitted by the engineer.

The blocks will be carefully inspected after they are brought on the work. Nothing but whole blocks shall be used, except in starting a course or in such other cases as shall be especially permitted by the engineer, and in no case shall less than one-third of a block be used in breaking joints.

When laid the block shall be covered with clean, fine sand entirely free from loam or earthy matter, perfectly dry and screened through a sieve having not less than twenty meshes per linear inch.

Paving Country Roads.

The following table shows the length of country roads in Cuyahoga county, Ohio, in the vicinity of Cleveland, which have been paved with brick, macadam, bitulithic and asphalt during the years 1903, 1904 and 1905, and the cost of those which were completed at the date of the report. The pavements are all 14 feet wide, with strips of the ordinary country-road material on each side, 6 or 8 feet wide, with an edge stone between the pavement and the dirt roadway. The figures do not include any grading for reducing slopes, so that the cost of the various materials per foot of length or per square yard can easily be determined:

Name of Road.	Length in Miles.	Kind of Improvement.	Engineers Estimate.	Taxable to Property.	Payable by County.
Berea	1.50	Brick	$28,000	$3,184	$24,815
Brecksville	6.50	Brick	112,500	29,571	82,929
Brecksville	2.50	Brick			
Canal	2.00	Brick			
Coe Ridge	7.50	Brick			
Depot	1.25	Macadam	8,300	1,314	6,985
Detroit	3.00	Asphalt	116,600	69,071	47,528
Euclid	2.25	Brick	88,668	65,515	23,152
Kinsman	4.50	Bitulithic	95,000	37,742	57,257
Miles ave. No. 2	3.00	Brick			
Noble	2.50	Brick	48,643	30,943	17,699
North Ridge	2.25	Brick	66,500	24,189	42,311
North Ridge No. 2	6.00	Brick			
North Woodland	7.25	Macadam	61,000	22,802	38,197
Parma-R-Center	3.50	Macadam	79,000	24,121	54,878
Prospect	1.50	Brick	42,000	3,290	38,710
Richmond No. 1	3.75	Macadam	16,000	1,816	14,184
Richmond No. 2		Macadam	8,700	2,187	6,512
River	.50	Brick	12,000	4,803	7,197
Schaaf	3.00	Brick			
State No. 1	3.00	Bitulithic	70,520	34,535	35,984
State No. 2	.50	Brick	23,400	16,367	7,033
State No. 3	8.00	Brick			
West Madison	2.50	Brick	65,000	26,822	38,177
Wooster	1.25	Brick	34,000	12,895	21,105
Wooster pike	8.00	Brick			

WATER AND LIGHT

Omaha Hydrant Rental—The Baltimore Water Problem—Delaware River Pollution—Toledo Water Purification—Chicago Drainage and Mississippi River—Hydrant Rentals—Electric Lighting Schedule.

Omaha Hydrant Rental Suit Decided.

Judge Munger, of the federal court, directed a verdict against the Omaha Water Company March 17 in its suit against the city of Omaha for approximately $100,000 for hydrant rental. The court held that the company had violated its contract with the city by its failure to place seventy-five hydrants ordered by the Water Board July 12, 1904. This order was ignored by the company, which alleged that the Water Board was prompted by a desire to depreciate the value of its plant in view of appraisement proceedings, and also that there was no money in the city treasury with which to pay for the additional hydrants. Judge Munger held that the debt for these hydrants was incurred when the contract between the city and the company was made in 1883. A counter claim of the city for $80,000 additional expense incurred in maintaining the fire department and fire engines, which would not have been necessary had the water pressure been up to contract requirements, was dismissed.

The Water Problem of Baltimore.

Like many other cities, Baltimore is up against a serious problem in making provisions for its future water supply. At present the city receives its water supply from two sources—the Gunpowder river, which has an average daily flow of 170,000,000 gallons, and Jones Falls, with 35,000,000 gallons. The system includes two impounding reservoirs having capacities of 410,000,000 and 400,000,000 gallons, respectively. In addition to this there are seven storage reservoirs, the total capacity for clear water aggregating 1,388,875,000 gallons. In order to raise the pressure in certain localities two standpipes are used, each having a capacity of 300,000 gallons. The system includes 645 miles of water main, varying from 1½ inch to 48 inches. The service pressure about the city varies from 20 to 90 pounds per square inch. The total revenue for the support of the department in 1905 amounted to $908,973.82.

The city was faced with the same problem in 1870 with its 275,000 inhabitants as now with its 600,000 population. The water supply at that time was not sufficient for the immediate future, and the same situation is present to-day. Unfortunately there has developed an opposition from Baltimore county, which is involved in the question as to where the increased supply shall be secured. The situation is more urgent to-day for the reason that there is more water used per capita than in 1870. Then the city was using 10,000,000 gallons per day, with a per capita consumption of 36 gallons. The average water consumption of the city to-day is 64,000,000 gallons per day, or 106 gallons per capita. Taking this as a basis, it is deemed expedient by those who have the problem under consideration to build a new reservoir with a total capacity of 20,000,000,000 gallons. While considerable opposition has developed against the proposition to secure the increased supply of water from the Gunpowder valley, it is generally believed that the outcome will be all that is desired.

Toledo's Water Purification Contract Enjoined.

Judge Barber in Common Pleas Court, sustained the injunction to prevent the city of Toledo, O., carrying out the contract with the Norwood Engineering Company for the construction of a water purification plant. Judge Barber ignored the point upon which the greatest stress was placed by both sides—that of the authorized delegation of power by Council to the Board of Public Service. Instead, the decision for the plaintiff was given on the ground that the Norwood contract, amounting to $483,327, for the filter plant proper, is at such a price as to make the entire cost of the filtration works in excess of $565,000, the amount appropriated. Under present plans the engineer's estimate of the cost of the work is $775,039.

Judge Barber said:

I find in favor of the plaintiff, on the ground that the Board of Public Service exceeded its power in making contracts

for part of the work, which would prevent the construction of the entire filtration plant for less than $775,000, when the Council had limited the expenditure for that purpose to $565,000.

Notice of an appeal was given.

Pollution of Delaware River Becoming Serious.

At a conference held at the Philadelphia Club March 10 Governor Pennypacker, of Pennsylvania, and Governor Stokes, of New Jersey, with other officials of the two States, discussed plans to stop the pollution of the Delaware River, which is now endangering the health of the cities and towns along its banks. The officials of both States will begin at once active work to remedy the evils. Governor Higgins, of New York, will also be conferred with relative to the pollution of the Delaware above the New Jersey boundary, where the river drains a watershed of more than 20,000 square miles.

Chicago Drainage Does Not Pollute Mississippi River.

The United States Supreme Court decided recently that the Chicago drainage canal does not pollute the waters of the Mississippi river to any appreciable extent. The court finds that there was practically no evidence whatever that the sewage of Chicago reaches the intake of the water works at St. Louis in any appreciable quantity. Furthermore, that a typhoid-fever epidemic in Chicago is not followed by one in St. Louis, and that the increase of typhoid fever in St. Louis since the opening of the drainage canal is not sufficiently large as compared with the previous four years to justify anything like the certainty that Chicago sewage is responsible for the health conditions of St. Louis one way or another. In presenting the unanimous opinion of the court Justice Holmes said:

We have studied the plaintiff's statement of facts in detail and have perused the evidence, but it is unnecessary for the purposes of decision to do more than give the general result in a very simple way. At the outset we cannot but be struck by the consideration that if this suit had been brought fifty years ago it almost necessarily would have failed. There is no pretense that there is a nuisance of the simple kind that was known to the other common law.

There is nothing which can be detected by the unassisted senses—no visible increase of filth, no new smell. On the contrary, it is proved that the great volume of pure water from Lake Michigan, which is mixed with the sewage at the start, has improved the Illinois river in these respects to a noticeable extent. Formerly it was sluggish and ill-smelling. Now it is a comparatively clear stream, to which edible fish have returned. Its water is drunk by the fishermen, it is said, without evil results.

The plaintiff's case depends upon the inference of the unseen. It draws the inference from two propositions. First, that typhoid fever has increased considerably since the change and that other explanations have been disproved; and second, that the bacillus of typhoid can and does survive the journey and reach the intake at St. Louis in the Mississippi.

We assume the now prevailing scientific explanation of typhoid fever to be correct. But when we go beyond that assumption everything is involved in doubt. The data upon which an increase in the deaths from typhoid fever in St. Louis is alleged are disputed. The elimination of other causes is denied. The experts differ as to the time and distance within which a stream would purify itself. No case of an epidemic caused by infection at so remote a source is brought forward, and the cases which are produced are controverted.

The plaintiff obviously must be cautious upon this point, for if this suit should succeed, many others would follow, and it is not improbable would find itself a defendant to a bill by one or more of the States lower down upon the Mississippi.

The distance which the sewage has to travel (357) miles is not open to debate, but the time of transit to be inferred from experiments with floats is estimated at periods varying from eight to eighteen and a half days, with forty-eight hours more for intake and distribution, and when corrected by observation of bacteria is greatly prolonged by the defendants.

The experiments of the defendant's experts lead them to the opinion that a typhoid bacillus could not survive the journey, while those on the other hand maintain that it might live and keep its power for twenty-five days or more, and arrive at St. Louis. Upon the question at issue, whether the new discharge from Chicago hurts St. Louis, there is a categorical contradiction between the experts on the two sides.

The Chicago Drainage Canal was opened January 27, 1900. The deaths from typhoid fever in St. Louis before and after that date are stated somewhat differently in different places. We give them mainly from the plaintiff's brief: 1890, 140; 1891, 165; 1892, 441; 1893, 215; 1894, 171; 1895, 106; 1896, 106; 1897, 125; 1898, 95; 1899, 131; 1900, 154; 1901, 181; 1902, 216; 1903, 281. It is argued for the defendant that the numbers for the later years have been enlarged by carrying over cases which in earlier years would have been put into a miscellaneous column as intermittent, remittent, typhoid-malaria, etc., but we assume that the increase is real.

What the future may develop, of course, we cannot tell, but our conclusion upon the present evidence is that the case proved falls so far below the allegations of the bill that it is not brought within the principles heretofore established in the cause.

Nevertheless, comparing the last four years with the earlier ones, it is obvious that the ground for a specific inference is very narrow, if we stopped at this point. The plaintiff argues that the increase must be due to Chicago, since there is nothing corresponding to it in the watersheds of the Missouri or Mississippi. On the other hand, the defendants point out that there has been no such enhanced rate of typhoid on the banks of the Illinois as would have been found if the opening of the drainage

been found if the opening of the drainage canal were the true cause.

Both sides agree that the detection of the typhoid bacillus in the water is not to be expected. But the plaintiff relies upon proof that such bacilli are discharged into the Chicago sewage in considerable quantities; that the number of bacilli in the water of the Illinois is much increased, including the bacillus coli communis, which is admitted to be an index of contamination, and that the chemical anaysis leads to the same inference.

To prove that the typhoid bacillus could make the journey an experiment was tried with the bacillus prodigiosus, which seems to have been unknown, or nearly unknown in these waters. After preliminary trials, in which these bacilli emptied into the Mississippi near the mouth of the Illinois were found near the St. Louis intake and in St. Louis in times varying from three days to a month, 107 barrels of the same, said to contain 1,000,000,000 bacilli to the cubic centimeter, were put into the drainage canal near the starting point on November 6 and on December 4 an example was found at the St. Louis intake tower. Four others were found in the three following days—two at the tower and two at the mouth of the Illinois.

As this bacillus is asserted to have about the same length of life in sunlight in living water as the bacillus typhosus, although it is a little more hardy, the experiment is thought to prove one element of the plaintiff's case, although the very small number found in many samples of water is thougnt by the other side to indicate that practically no typhoid germs could get through.

It seems to be conceded that the purification of the Illinois by the large dilution from Lake Michigan (nine parts or more in ten) would increase the danger, as it now is generally believed that the bacteria of decay, the saphrophytes, which flourish in stagnant pools, destroy the pathogenic germs. Of course, the addition of so much water to the Illinois also increases its speed.

On the other hand, the defendant's evidence shows a reduction in the chemical and bacterial accompaniments of pollution in a given quantity of water, which would be natural in view of the mixture of nine parts to one from Lake Michigan. It affirms that the Illinois is better—or no worse—at its mouth than it was before and makes it at least uncertain how much of the present pollution is due to Chicago and how much to sources farther down, not complained of in the bill. It contends that if any bacilli should get through, they would be scattered and enfeebled and would do no harm.

The defendants also set against the experiment with the bacillus prodigiosus a no less striking experiment with typhoid germs suspended in the Illinois River in permeable sacs. According to this the duration of the life of these germs has been much exaggerated, and in that water would not be more than three or four days. It is suggested by way of criticism that the germs may not have been of normal strength; that the conditions were less favorable than if they had floated down in a comparatively unchanging body of water, and that the germs may have escaped, but the experiment raises at least a serious doubt.

Further, it is hardly denied that there is no parallelism in detail between the increase and decrease of typhoid fever in Chicago and St. Louis. The defendants' experts maintain that the water of the Missouri is worse than that of the Illinois, while it contributes a much larger proportion to the intake. The evidence is very strong that it is necessary for St. Louis to take preventive measures, by filtration or otherwise, against the danger of the plaintiff's own creation or from other sources than Illinois. What will protect against one will protect against another. The presence of causes of infection from the plaintiff's action makes the case weaker in principle as well as harder to prove than one in which all came from a single source.

Some stress was laid on the proposition that Chicago is not on the natural watershed of the Mississippi because of the rise of a few feet between the Des Plaines and the Chicago rivers. We perceive no reason for a distinction on this ground. The natural features relied upon are of the smallest, and if under any circumstances they could affect the case, it is enough to say that Illinois brought Chicago into the Mississippi watershed in pursuance not only to its own statutes, but also to the acts of Congress of March 30, 1822, and March 2, 1827, the validity of which is not disputed. Of course these acts do not grant the right to discharge sewage, but the case stands no differently in point of law from a suit brought because of discharge from Peoria into the Illinois or from any other or all the other cities on the banks of that stream.

The case originated in a suit filed by the State of Missouri to restrain the discharge of the sewage of Chicago through an artificial channel into the Mississippi River. The demurrer of the State of Illinois and the sanitary district was overruled and a supplementary bill filed by the State of Missouri alleging that since the filing of the original bill the drainage canal had been opened, producing all the evils which were apprehended when the injunction was first asked.

In disposing of the demurrer the Supreme Court of the United States left the question of jurisdiction to the future with the general intimation that the nuisance must be made out upon determinate and satisfactory evidence; that it must not be doubtful, and that the danger must be shown to be real and immediate.

The court, in its latest opinion, stated that the nuisance set forth in the bill was one which would be of international importance—a visible change of a great river from a pure stream into a polluted and poisoned ditch. Regarding jurisdiction the court said the only question presented was whether as between the States of the Union this court was competent to deal with a situation which, if it arose between independent sovereigns, might lead to war. Whatever difference of opinion there might be upon matters of detail the jurisdiction and authority of this court to deal with such a case as that is not open to doubt.

The court holds that a case such as made by Missouri may be a ground for relief. It may be imagined that a nui-

sance might be created by a State upon a navigable river like the Danube, Justice Holmes said, which would amount to a casus belli for a State lower down unless removed. If such a nuisance were created by a State upon the Mississippi, the controversy would be resolved by the more peaceful means of a suit in the Supreme Court of the United States.

As to the principle to be laid down, the caution necessary is manifest. It is a question of the first magnitude whether the destiny of the great rivers is to be the sewers of the cities along the banks or whether they are to be protected against everything which threatens their purity. To decide the whole matter at one blow by an irrevocable fiat would be at least premature. If we are to judge by what the plaintiff itself permits, the discharge of sewage into the Mississippi by cities and towns is to be expected. We believe that the practice of discharging into the river is general along its banks, except where the levees of Louisiana have led to a different course. The argument for the plaintiff asserts it to be proper within certain limits.

There are other facts to be considered. Even in cases between individuals, some consideration is given the practical course of events. In the Black country of England parties would not be expected to stand upon extreme rights. Where, as here, the plaintiff has sovereign powers and deliberately permits discharges similar to those of which it complains, it not only offers a standard to which the defendant has the right to appeal, but, as some of those discharges are above the intake of St. Louis, it warrants the defendant in demanding the strictest proof that the plaintiff's own conduct does not produce the result or at least so conduce to it that the court should not be curious to apportion the blame.

The case is dismissed without prejudice, and should the State of Missouri be able at some later date to produce more convincing evidence, the court will be open to it.

How to Make a Schedule of Electric Lighting Rates.

A report was submitted on March 16, 1906, to the Committee on Gas, Oil and Electric Light of the Chicago City Council by B. J. Arnold, consulting engineer, and William Carroll, city electrician, which considers very carefully the principles upon which the rates for electric light for private consumers should be determined. The Chicago Edison Company and the Commonwealth Electric Company, furnish light to the citizens of Chicago by the Wright demand system. With this system two meters are connected for each customer, one (the watt meter) to show the kilowatt-hours of electrical energy actually supplied during the month, and the other (the maximum meter) to show the greatest demand made at any one time. The charge for current is made at the rate of twenty cents per kilowatt-hour for that amount of energy equal to a thirty hours' use of the capacity indicated by the maximum-demand meter, and at the rate of ten cents per kilowatt-hour for all current in excess of this amount. The maximum charge is subject to a discount of 20 per cent. for the prompt payment of the bill, and the low rate charge is subject to varying discounts according to quantity used. No minimum is charged. The original installation of lamps and lamp renewals are furnished free.

The intention of this system of charging is, as far as possible, to make each customer pay not only for the cost of actually producing his current, but also to stand his equitable share of the fixed charges upon the investment which it has been necessary to make in order to get ready to serve him. The demand meter differentiates between "short-hour" users and "long-hour" users, and gives the benefit of the lower or secondary rates to a customer only after he has paid for sufficient current at the maximum rate to reimburse the company for the use of its capacity as indicated by the maximum meter.

The working of the Wright demand system to its logical conclusion would mean that each customer would stand on his own feet and pay for the actual and equitable cost of his service plus a profit. On the other hand, if the maximum charge is reduced, the lighting companies will be forced to do a certain amount of their business at a loss; that is, the "short-hour" consumers—who are the ones most affected by the minimum rate—will be getting their current at less than actual cost, and the loss must be made up by a reduction in income or by making higher than would otherwise be necessary the rate to the "long-hour" consumer.

As other merchants consider it to their interest to do a certain amount of their small business at a loss it is not surprising to find that public sentiment is in favor of reducing the maximum rate for lighting, even if the supply company must make up his loss by a slightly larger charge than would otherwise be made upon their larger sales. The problem, therefore, resolves itself into the establishing of a fair balance.

The discussion of the problem has been divided into two parts:

First: What is a reasonable maximum rate on the assumption that the companies cannot be compelled to accept less than cost?

The maximum rate of the Edison and Commonwealth companies at the present time is 20 cents per kilowatt-hour, with 20 per cent. discount on the maximum part of the bill for prompt payment, leaving a

net maxim rate of 16 cents per kilowatt-hour, which has been in force since July 1, or a reduction of 20 per cent. in the maximum rate during the last year.

The minimum rate may be altered by changing the maximum part of the rate to 15 cents down to 10 cents, as may be agreed, leaving the secondary part of the rate at its present amount, viz.: 10 cents. The reduction to 10 cents without changing the secondary rate would thus ultimately result in a "flat" rate, irrespective of the amount or character of the demand; or by changing the time during which the demand registered by the maximum meter must be used before the customer gets the benefit of the secondary rate. At present this maximum demand (in kilowatts) is multiplied by 30 (hours) to get the kilowatt hours which must be used at the maximum rate before the secondary rate is applied. This might be reduced to 20, 15, or 10 hours, reducing the customer's bill. It should be borne in mind that the maximum-demand meter does not indicate the length of time during which this greatest demand continues. Whether or not this system works an injustice depends upon the character of the customer's load. For instance, in the case of a flat owner using his maximum number of lights for only two or three evenings in a month the practice of charging for 30 hours' use of this maximum capacity would be wrong, but to a restaurant-keeper using his maximum capacity for four or five hours a day, or 150 hours per month instead of thirty, the practice of using the constant 30 is not unfavorable to the user.

There can be no doubt that with the maximum rate as at present some customers are served at a loss. In fact, figures have been compiled by the companies showing that a large percentage of their customers are supplied at present at less than cost. In spite of this fact, however, the companies have evidently thought it best to reduce their maximum rates, which indicates their willingness to do a certain amount of business at a loss. If this is "reasonable," how far can it be carried?

We are satisfied that perhaps 25 per cent. of the customers are not producing a profit. A reduction in the maximum rate will naturally increase the number of customers in this class, which number is claimed by the companies to be at the present time over 10,000.

Although the number of customers getting served at a loss may appear large, the total amount of actual loss to the companies when measured in dollars compared to the total income from all lighting customers is small, for it is only those using a small amount of current that are supplied at a loss.

It is only by arbitrarily reducing the maximum rate in one of the ways indicated above that the "short-hour" customers will get the benefit of advances made in the art. For instance, the actual cost for fuel used in producing the electric current of the companies under discussion is such a small proportion of the total cost of supplying a small or "short-hour" customer that if some method were discovered whereby the cost of fuel could be entirely eliminated, the investment remaining the same as at present, the reduction in the maximum rate, if the entire benefit were to be given to the customers, would only amount to ½ cent per kilowatt hour. To a customer paying the 16-cent rate this reduction would not be material, while to a wholesale customer getting energy say at 4 cents per kilowatt-hour, a reduction of ½ cent per unit would produce a considerable saving.

Improvements are being made in the art of generating and distributing electrical energy which are gradually decreasing the cost. The volume of the electric lighting business in Chicago is increasing rapidly, and this increase is rapidly decreasing the cost of each unit of current distributed. The larger sizes of the generating units now available make the cost of getting ready to serve each customer less each year. The use of batteries to insure reliability of service and the extension of the circuits into larger and more sparsely settled territory are offsets, however, to the general tendency toward a reduction in cost.

If the companies are not to be expected to do any business whatever at a loss, then the present maximum rate cannot be reduced.

Second: What is a reasonable rate on the assumption that the companies can be required to serve a portion of their customers at less than cost, provided the returns of the total lighting business are reasonably profitable?

There are a large number of combinations of the maximum and minimum rates which can be made. The companies are willing to agree, under certain named conditions, to reduce their present rates of 16 cents and 10 cents to a maximum of 14 cents and a secondary of 9 cents for the next two years, with a further reduction to 12 cents for the maximum rate and 8 cents for the secondary for the last three years of the next five-year period.

In order to show the relative influence of these suggested rates upon the income of the companies as compared with other

rates, including a flat rate of 10 cents per kilowatt-hour, the following table has been compiled:

Possible Changes in Rates in Cents per Kilowatt-Hour.	*Relative Total Income at Various Rates.*	*Percentage Decrease in Total Income at Various Rates.*
20 and 10	100.0 per cent.	None.
16 and 10	92.8	7.2 per cent.
16 and 10—with 10 hrs. time limit. 14 and 10—	89.2	10.8
14 and 9—Suggested by companies for 2 years. 12 and 10—	85.8	14.2
14 and 8 12 and 9 10 and 10 flat rate	82.3	17.7
14 and 7 12 and 8—Suggested by companies for last 3 years	78.8	21.2
12 and 6	71.6	28.4

The above table shows that:

a. The reduction of rates already in force makes a reduction in gross income from lighting of 7.2 per cent, not including the loss sustained by waiving the minimum charge, which was done at the same time.

b. The reduction of rates for the first two years to 14 cents and 9 cents, as suggested by the companies, means a further reduction of 7 per cent. from their original income.

c. The reduction to 12 cents and 8 cents, on account of the fact that the amount sold at the secondary rate averages twice the amount sold at the primary rate, is the same as an average flat rate of 9 1-3 cents.

To determine whether or not it would be reasonable to ask the companies to do more at this time than they have indicated their willingness to do, a careful study and analysis has been made of the figures which they have submitted with the following results:

The full valuation of the properties and franchises as fixed by the Board of Equalization for taxation purposes is $25,707,000.

The sum total of the outstanding bonds and stocks does not exceed the published investment upon which interest and dividends are paid. That is, dividends are not paid upon stock which represents the value of the franchise. No bonds or stock have been recalled, however, to take care of depreciation.

Interest at the rate of 5 per cent. is paid on the bond issue and dividends at the rate of 8 per cent. annually are paid on the stock issued. The average annual charge for interest and dividends is 6.5 per cent. on the total par value of the bonds and stock.

The surplus earnings over and above interest charges are allowed to remain in the property to overcome the depreciation. It appears from the figures submitted that the companies have not been earning sufficient surplus to equal an average depreciation of 6 per cent., land not included.

The lighting load is increasing at about the rate of 7,500,000 kilowatt-hours each year.

The operating costs are decreasing gradually as improvements are made and economies are introduced, but the income per kilowatt-hour has decreased in about the same proportion, which means that the large users and not the companies have been getting the larger proportion of the benefit of the increased economies due to the improvements.

The investment per kilowatt of connected load is now only about one-half as much as it was five years ago and it is on account of this decrease in investment per unit of capacity that the price of energy sold may be expected to decrease.

The percentage of current sold compared to the amount generated is decreasing instead of increasing. This is due to an increase in transmission and sub-station losses incidental to serving a larger territory.

The ratio of net earnings to gross earnings of the Chicago companies is slightly less than the average of a number of lighting companies in other large cities.

After a very careful study of the situation the conclusion reached is that the Edison and Commonwealth companies can afford to reduce their lighting rates.

If there is no desire on the part of the

city to embarrass these companies in their efforts to extend their lines and to fender efficient and reliable service, then their offer to reduce their rates to 14 cents for the maximum rate, and 9 cents for the secondary rate, for two years from the present time, and to 12 and 8 cents for the next following three years, may be considered reasonable and fair.

A thorough investigation of the affairs of the companies might show that these companies could afford to reduce their rates to 10 cents and 5 cents (equivalent to a flat rate of 6 2-3 cents), but from all figures which have been submitted this rate at the present time would be a hardship and would probably seriously embarrass the companies, but it is reasonable to expect that the companies can afford to and probably will eventually reach this latter rate.

Hydrant Rentals in Various Cities.

A new revised ordinance providing for a lower rate for city water hydrants has been submitted by the water-works company at Pekin, Ill., to the City Council. This proposed reduction has brought about a comparison of rates in forty cities in the United States, some of which, with their population, the number of hydrants, and the rate paid, are as follows:

Rates for Fire Hydrant Service.

City and State.	*Hyd'ts.*	*Rate.*	*Pop.*
Manitowoc, Wis.	172	$46.50	11,785
Knoxville, Tenn.	270	45.00	32,637
Denison, Tex.	121	79.25	11,807
Owensboro, Ky.	163	43.00	13,189
Butte, Mont.	426	63.29	30,470
Lincoln, Ill.	113	42.50	8,962
Champaign, Ill.	210	40.00	16,728
Oskaloosa, Ia.	116	54.75	9,212
Richmond, Ind.	502	47.70	18,226
Sedalia, Mo.	185	40.00	15,231
Baton Rouge, La.	90	66.67	11,269
Belleville, Ill.	167	74.50	17,484
St. Joseph, Mo.	829	40.00	102,979
Raleigh, N. C.	166	40.00	13,643
Alton, Ill.	139	60.00	14,210
Dixon, Ill.	172	57.00	7,917
Freeport, Ill.	147	55.00	13,258
Pontiac, Ill.	67	42.00	4,266
Peoria, Ill.	1167	37.86	56,100
Average		51.98	
Pekin, old rate		38.45	
Pekin, new rate		35.00	

MUNICIPAL AND TECHNICAL LITERATURE

Municipal Reports—New Publications.

Municipal Reports

Report of the Bureau of Water, Department of Public Works, Schenectady, N. Y., for year ending Nov. 1, 1905. Geo. T. Ingersoll, Superintendent.

In the report of this department for 1904 was a statement of the difficulties met in starting the new electrical pumping station, the first of its size. Mechanical and theoretical difficulties presented themselves and it was necessary to put in two new pumps, the failures of the first pumps being repeated. The new pumps are two-phase centrifugal turbines and can pump from the wells 12,000,000 gallons a day, double the average consumption. They had been in operation about fourteen months at the date of the last report and the superintendent now says that all the water is pumped electrically and there is no likelihood of the steam pumps ever being used again, though they have been kept in readiness all the year. The electric plant is fully as reliable as a new steam plant would have been and the cost of repairs will be much less. There was an intermission of about two hours during an ice gorge in the spring due to damage done to the transmission line poles by the ice, which was serious but was quickly repaired.

The report of George Holtzman, Superintendent of Public Works, which precedes the water department report, states that the works are now self-supporting, paying $56,000 to sinking fund and $36,000 interest besides all expenses and having $13,000 balance last year and an estimated surplus next year of $53,000 more than will be necessary for extensions and the contemplated extensions of stand pipes. The consumption is 99 gallons per capita per day.

New rules and regulations were adopted

during the year. Under them property within 1,000 feet of a fire hydrant is taxed 1.4 mills per dollar of valuation and property beyond that distance 2½ mills, whether water is used or not. Comparatively low flat rates for dwellings are established and meter rates from 22 cents for 100 cubic feet for an average use of 2.7 cubic feet a day to 6 cents for more than 7,000 cubic feet a day. The Bureau of Water has the right to put in meters at any time and consumers can put in approved meters if they so desire, the minimum charge to be for 60 gallons a day for each person in the building.

Fifty-third Annual Report of the Board of Water Commissioners of the city of Detroit, 1905. Clarence W. Hubbell, Civil Engineer.

The principal event of the year was the practical completion of the new intake tunnel, which was begun in 1904 and was described in the report for that year. The river tunnel is 10 feet in diameter and 3,175 feet long. It was driven through tough blue clay and nearly all of it is lined with four rings of vitrified brick. The maximum length of tunnel completed in one month was 454.5 feet in January, 1905, under very severe weather conditions and the largest day's work was on January 23, when 21.2 feet was excavated and bricked up. Air pressure was used, beginning at 10 pounds and reaching 28 pounds when near the end, the maximum being 33 pounds during passage through a little treacherous ground. There were no serious accidents and no loss of life. An intake crib and tower is located over the end of the tunnel, which is in the American channel of the Detroit River, 800 feet above the head of Belle Isle. A shore tunnel, 1,032 feet long, connects the shore end of the intake tunnel with the settling basins and the pumping station.

The civil engineer of the board, Mr. Clarence W. Hubbell, made a careful study of the relations of population to water supply in the 1904 report, and computed the probable number of persons in each family for each year up to 1910. The number for 1905 is 4.65 persons per family, which indicates a population for that year of 341,931. The consumption of water per capita was 179 gallons, an increase from 168 in 1904. Notwithstanding the increase in population, the care taken of the plant and the attention paid to the design of additions and improvements has resulted in an increase in the pressure of water at hydrants of 21 per cent. in ten years, the average pressure now being 23.5 pounds. The increase in daily consumption in the same period has been 61 per cent. and the increase in number of persons supplied has been 49 per cent. during the same period.

New Publications.

Osborn's Tables of Moments of Inertia and Squares of Radii of Gyration, to which have been added tables of the working strengths of steel columns, the working strengths of timber beams and columns, standard loads and unit stresses, and constants for determining stresses in swing bridges. Fifth revised edition, 184 pp., leather, $3. The Osborn Engineering Co., Cleveland, O.

This edition of the well-known Osborn's Tables has been revised to conform to the present standards of mill sections and shapes and the combinations of such shapes, which are figured are in accordance with present designing practice. The usefulness and convenience of the book for every day office practice are therefore much enhanced. The addition of the tables of safe working strengths of soft and medium steel columns will meet the needs of a number of enquirers. They include columns with square bearing, pin and square bearing, and pin bearing for values of the square of the length divided by the radius of gyration from 1 to 400.

Coefficients for determining the shears, reactions and moments in swring bridge trusses of various designs are given, so that for given panel load and length of panel the actual values can be readily obtained.

Bearing and shearing area of rivets, resistance of webs to buckling, centrifugal force, portal bracing, camber, length of flange plates, bending moments for timber joists and for beams loaded through joists, timber column loads, standard bridge loadings for steam and electric railroads are some of the valuable tables which are given.

Economic Geology of the United States. By Heinrich Ries, A. M., Ph. D., Assistant Professor of Economic Geology at Cornell University. 435 pp. $2.60 net. The Macmillan Company, New York.

Professor Ries has prepared a book to cover an elementary course on econom geology, which will also be of much value to those desiring to get a good general idea of the importance of the various mining industries and of the extent of occurrence of the various minerals of economic importance. The connection of Professor Ries with the New York State Geological Survey and with the United States Geological Survey has given him excellent opportunities for personal experience in observation of deposits in certain

parts of the country, which he has improved and he has also expended much research upon the publications of the various State and national surveys, books and periodicals, and has given the results of this labor in this book.

The titles of the chapters will show the extent of the work and the number of pages devoted to each subject, indicated by the figures following the respective titles, will give an idea of the amount of detail which he has been able to include within the limits of the book. Coal occupies 36 pages; petroleum, gas and other hydrocarbons, 30; building stone, 23; clay, 17; lime and calcareous cements, 15; salines, 15; gypsum, 18; fertilizers, 11; abrasives, 9; minor minerals, 37; water, 9; soils and road materials, 7; ore deposits, 28; iron, 26; copper, 25; lead and zinc, 22; gold and silver, 39; silver-lead, 11; aluminum, manganese and mercury, 21; minor metals, 12 pages. The book is well illustrated with photographs and drawings which have direct relation to the text.

ORGANIZATIONS AND INDIVIDUALS

National Municipal League—U. S. Civil Service—Hydraulic Laboratory—Columbia Improvement League—Technical Meetings—Personal Notes.

The National Municipal League.

The National Municipal League and the conference for good government will be held at Atlantic City, N. J., April 24 to 27.

The president of the league is Hon. Charles J. Bonaparte, Secretary of the Navy, and his address will be delivered on the evening of April 26. The annual review of the work of the league under the title "Practical Progress," will be given on the first day of the meeting by Clinton Rogers Woodruff, secretary.

The day sessions of Wednesday will be devoted to recent significant experiences in municipal reform. These will include descriptions of the conditions prevailing in leading American cities, as New York, Philadelphia, Pittsburg, Indianapolis, Denver, Cincinnati, Louisville and St. Paul. Wednesday evening there will be a mayor's meeting, with Hon. George W. Guthrie, of Pittsburg, as the presiding officer. Among the other speakers will be Mayor Weaver of Philadelphia, Mayor Johnson of Cleveland, Mayor Jones of Johnson of Cleveland, Mayor Jones of Minneapolis, and Mayor Cutler of Rochester.

Friday's session of the meeting will be devoted to municipal ownership and operation of public utilities in American cities, with reports from Cleveland, Logansport, Jacksonville, Detroit, Duluth, Haverhill, Holyoke and Norwich. There will also be considerable attention paid to the Civic Federation investigation of the municipal ownership problem.

During the meeting of the league there will be at least two round table conferences for the informal discussion of ways and means. Among the other subjects which will have place on the program are the following: United States platform, the acceptance of municipal accounting, juvenile civic league activity, Ohio's experience with uniform accounting and reporting, the referendum and the initiative, franchise, police question.

Among the prominent gentlemen who will deliver addresses during the sessions of the meeting, in addition to those already mentioned, are the following: Richard Henry Dana, Boston; Elliott H. Pendleton, Cincinnati; Charles Richardson, Philadelphia; E. R. Cheeseborough, Galveston; Lawrence Veiller, New York; A. C. Freiberg, Cincinnati; Lafon Allen, Louisville; Thomas Raeburn White, Philadelphia; Dr. Geo. E. Hunt, Indianapolis; Graham Romeyn Taylor, Chicago; L. G. Powers, of the Census Bureau, Washington; Joseph T. Tracy, of the State Auditor's office, Ohio; Dr. E. M. Hartwell, city statistician of Boston; L. N. Case, manager of the Water Commissioners, Duluth; Frank J. Goodnow, Columbia University; Dr. E. W. Bemis; Louis F. Post, Chicago; Delos F. Wilcox, Grand Rapids.

United States Civil Service Examinations.

The United States Civil Service Commission will hold examinations at the usual places on April 18 for engineer and carpenter in Indian service at Winnebago, Neb., at $660 a year, and on April 11 for engineer and sawyer at the Navajo Agency, New Mexico, at $800 a year.

New Hydraulic Laboratory.

The hydraulic laboratory of the University of Utah, which is now nearing completion, will perhaps be one of the very best and most thoroughly equipped laboratories to be found anywhere. It is proposed to have in this laboratory every kind of modern apparatus that is used in performing experiments with water. The canals and apparatus to be put into this laboratory at this time will cost some $15,000.

It will be fully equipped for testing and experimenting with hydraulic apparatus of all kinds.

The Improvement of Columbia, S. C.

A comprehensive report on the "Improvement of Columbia, S. C." has been prepared for the Civic Improvement League of that city by Kelsey & Guild, landscape architects of Boston, Mass. This report is being printed in artistic pamphlet form by the J. Horace McFarland Press, Harrisburg, Pa., and will contain 88 pages. It will be beautifully illustrated with half-tone engravings and colored maps showing the proposed park systems, etc. The matter is presented in an attractive manner and will be of interest to cities all over the country. Copies of this report may be had from the president, Miss Belle Williams, Civic Improvement League, Columbia, S. C., for 50 cents each.

Technical Meetings.

The Cement Block and Concrete Workers' Association of Oklahoma and Indian Territories was recently organized at El Reno, O. T. Oklahoma City was chosen for permanent headquarters of the association, with W. I. Wasson, late of Pond Creek, in charge. Mr. S. Myers, of Shawers are not entitled to hold it, as it is a organization is to wrest control of the cement business of the two territories from the lumber trusts. The lumber dealers are not entitled to hold it, as it is a very small factor of the building business; yet they have been holding the cement trade as in a vise and controlling the prices. The cement contractors have tired of this situation and have determined by organization to revolutionize conditions in this respect."

The twenty-ninth annual convention of the National Electric Light Association will be held in Atlantic City, N. J., June 5-8, 1906. Paul Luepke, editor, has issued the first list of questions for the 1906 question box and will send copies of it on request. It includes 364 questions, on all subjects—buildings, power plants, district heating, electric installation, lines and appurtenances, contracts, accounts, management, advertising and legal, there being twenty-seven heads in the classification. Answers are invited from all, with the reasons for them.

A convention of cement users in Iowa, Minnesota and Nebraska was held at Mason City, Ia., March 21-23.

Personal Notes.

Mayor T. H. Gibbs, of Columbia, S. C., has been re-elected.

George S. Hanes has been appointed city engineer at Windsor, Ont.

David A. Gilland, ex-mayor of Altoona, Pa., died March 21, of paralysis.

E. H. Cary has been appointed village engineer at Green Island, N. Y.

Richard Turner has been appointed city engineer of Fulton, Ky.

D. C. Miller has been elected president of the Cleveland Civil Engineers' Club.

Morris Ebert, the importer of German cement, has removed his office to 119 S. Fourth st., Philadelphia, Pa.

John E. Hill has resigned as city engineer of St. Cloud and will remove to Anoka, Minn.

Mayor Boehne, of Evansville, Ind., proposes a municipal street sprinkling and street cleaning department.

Freeman C. Coffin has been elected chairman of the sanitary section of the Boston Society of Civil Engineers.

John J. R. Croes, past president of the American Society of Civil Engineers, died at Yonkers March 17, aged 72 years.

A. E. Kimberly has been appointed special assistant to Chief Engineer R. Winthrop Pratt, of the Ohio State Board of Health.

Judge William H. Moore, municipal ownership candidate for mayor of Seattle, Wash., was elected with a majority of 15 votes.

F. L. Knight & Sons, Crown Point, Ind., are city engineers of Valparaiso and town engineers of Hobart and Lowell, Ind.

O. Offerdahl, recently of Seattle, has been appointed city engineer of Sedro-Woolley, Wash., in place of S. T. Springer, who resigned recently.

H. B. Warner has resigned his position with the American Cement Co. and is now with the Peerless Portland Cement Co., Union City, Mich.

Prof. W. D. Pence has resigned his position at Purdue University to become professor of railway engineering at the University of Wisconsin.

William R. Conard, Asso. Am. Soc. C. E., engaged in the inspection and test of

materials, has removed his office to the Savings Institution building, Burlington, N. J.

William B. Pierce has been re-elected mayor of Bangor, Me. Henry J. McCarthy, J. Edward Sullivan, A. H. Harding, C. L. McCurdy, Chas. L. Snow, Chas. R. Dutton and T. B. Towle were elected aldermen.

Wm. J. Parkes resigned his position as city engineer at Bessemer, Ala., taking effect April 1, at which time he became city engineer of Pine Bluff, Ark., at a salary of $2,000 a year.

F. C. Willbrand has been appointed sales manager of the Northampton Portland Cement Co., succeeding Mr. Bernard, with office at 26 Broadway, New York city.

Major Cassius E. Gillette has resigned his commission in the Corps of Engineers, U. S. Army, to become chief engineer of the bureau of filtration of Philadelphia, Pa., at a salary of $17,000 a year.

Prof. I. O. Baker, of the University of Illinois, has been appointed assistant engineer in charge of bridge plans and specifications by the Illinois State Highway Commission.

In resigning his position as commissioner of public works of Chicago, Mr. Joseph M. Patterson wrote Mayor Dunne a letter in which he detailed the violations and neglects of laws which he finds.

A. Lincoln Acker resigned as director of public works of Philadelphia on March 5 and was succeeded by Thomas L. Hicks, who has been serving as assistant director.

Mr. Dana Pierce has been engaged by the Underwriters' Laboratories, 382 Ohio st., Chicago, Ill., as engineer in charge of electrical work. He began his duties in March, spending a few days at the New York office of the laboratories, and at Pittsburg in the annual conference between experts in the employ of insurance interests, and took up his active duties at the executive offices and testing station of the laboratories in Chicago about the 15th.

MACHINERY AND TRADE

Use of Cement by Railways.

The increase in the use of cement by railroads has been indicated in the large number of concrete pier s,abutments and number of concrete piers, abutments and verts and concrete shop buildings which have been built of late. A fair idea of its increase may be had from the figures from five roads, representing 32,523 miles of main line:

1903.....396,100 barrels.
1904.....410,000 barrels.
1905.....504,600 barrels.

The roads selected represent an average expenditure for extensions and betterments, and although all are trunk lines, it may be pointed out that it is the trunk lines which represent the normal increase, the use of concrete by the smaller roads having jumped from practically nothing in the last three years following the demonstration of its qualities by the larger ones.

One prominent manufacturer estimated that the amount of cement used by the roads, large and small, during the past year would average 50 per cent. more in 1905 than in 1903. The estimate is fairly well borne out by the above figures. That the rate of increase for 1905 is not abnormal is indicated by an official statement from one road, which estimated the consumption of cement in 1906 at double that of 1905, and by advice from the other roads that their purchases of cement would be larger than in any preceding year.—*Railway Age.*

Report on the Government Fuel Investigations.

The final report covering the investigations during 1904 at the Fuel Testing Plant at St. Louis, Mo., under the United States Geological Survey, has been published by the Government and is now ready for distribution. The report will appear in three volumes as Professional Paper No. 48, and will be distributed free of charge. Persons desiring copies of the report should apply for the same to a member of Congress from their district, or to a Senator from their State.

Canadian Cement Market.

According to Consul Shepard, Hamilton has invited tenders for supplying cement for the season of 1906. He says that American manufacturers secured these contracts for the past five years, and the Hamilton rate has been made the basis of contracts with other Canadian cities. Last year the price, delivered free in Hamilton, was $1.55½ per barrel of 350 pounds. The

consumption by the city was 4,000 tons, and a large amount besides was sold to private parties at the same rate. The duty is 12 cents per hundredweight on cement and 20 per cent. ad valorem on sacks. A Hamilton paper says that Canadian cement dealers have no valid complaint when they cannot meet American prices.

Consul Chilton writes from Toronto, in reply to an inquiry from a Michigan cement company, that there are many cement mills in Canada, and that the importations from the United States are based more on quality than the question of supply. Active building operations in Canada continue. The importations of cement for the five months ending November 30 were 1,785,000 hundredweight, mostly from the United States. The Canadian article just now sells for $1.60 per barrel of 350 pounds at the mill, with a customary rebate of 10 cents on returned bags. According to the statistics for 1904, Canada produced 58,600 barrels of rock cement, valued at $49,400, and 850,400 barrels of Portland cement, valued at $1,198,000. For the same year the importations of both were 2,476,000 hundredweight, valued at $925,017, of which about half came from the United States. The present rate of duty is 12½ cents per 100 pounds.

Bitulithic Pavement Increasing in Popularity.

The Warren Brothers Company is beginning the season with contracts for over 800,000 square yards of bitulithic, amounting to forty miles of roadway thirty feet wide. This is nearly three times the aggregate contracts carried over from the year 1904 to the year 1905 by this company. By action of the stockholders, at a meeting held on February 27, they have increased their capital a half million dollars by the issuance of first preferred stock for this amount bearing 6 per cent. cumulative dividends. The year 1905 was much the most profitable of the company since its organization.

Postmaster C. M. Palmer has written the following letter regarding the bitulithic pavements in Manistee, Mich.:

We have nearly three miles of this pavement in our city. It has been in use about four years and to all appearances is a better pavement today than when laid, does not show any wear at all, no water holes, is absolutely non-slippery, practically noiseless, free from dust, and in all regards so satisfactory that 98 per cent. of our property holders on the main business street petitioned our City Council to lay nothing but this pavement on their street, and notwithstanding that the company was the highest of six or more bidders, the contract was awarded to them last week for nearly 20,000 yards more of it. We would have nothing else in this city, and I believe your people will do well to investigate it thoroughly before accepting any other for your city. The company is absolutely reliable and will carry out to the letter any representation made by their representatives.

First Bitulithic Pavement in Texas.

The committee of taxpayers appointed with legal power to designate the pavement to be used in the improving of South Ervay street, Dallas, Tex., has made the following report to the Public Improvement Committee of the City Council:

We, the undersigned, a committee appointed by the property owners of Ervay street to confer with the City Council concerning the materials, plans and other matters regarding the proposed improvement of Ervay street, beg leave to report:

That we have had under consideration the various bids made by the contractors and filed with the city engineer, and after very careful deliberation recommend that the bid of C. H. Wells, for bitulithic pavement, construction of curbing and sidewalk be accepted and contract to be awarded to Mr. Wells.

And we further recommend and urge that the city lay a storm sewer before the work of pavement commences, because we have been advised that it would be impracticable to properly lay such a pavement without first constructing and laying a storm sewer.

This contract calls for 41,195 square yards of bitulithic at $2.35½ per square yard.

Concrete Sewers in St. Joseph, Mo.

The Union Terminal Railway Company, of St. Joseph, Mo., acquired some "made land" at St. Joseph by throwing the harbor line of the Missouri river west by means of a pile dyke. One condition of the franchise to the land calls for the extension of the main city sewers from the former stream face to the new harbor line in a manner satisfactory to the city engineer and the board of public works.

Mr. S. Waters Fox, chief engineer of the Union Terminal Railway Company, after investigation selected the reinforced concrete pipe of the Jackson Cement Sewer Pipe Company as best adapted to the requirements and stipulated that the sewer pipe company itself should not only make the pipe, but should also lay it and complete the sewer structure, the Union Terminal Railway Company providing the sub-structure, which is, in fact, bridge or trestle work. The first section of pipe was made December 26, and the contract was completed February 11, after extending three lines, 42-inch, 48-inch, and 72-inch respectively, and pipe was furnished for a 36-inch line. The whole of the com-

pleted work is above ground, on piling, stringers and cross-timbers, and every joint in the whole of the three lines is in full view the entire circumference of the pipe. Connection was made with the old brick sewers by sleeving over about four feet of the brick and the abutting section of pipe with concrete.

The sewage was turned into the new sewer extensions February 16, and the sewer pipe company showed its confidence in its own work by starting invitations February 14 to city engineers, railway maintenance of way engineers, members of boards of public works, and university professors to come to St. Joseph March 3 to view the work. There were representatives from four States, including two State universities, at St. Joseph on that day. The early part of it was given to viewing the work of the Jackson Cement Sewer Pipe Company. The whole of the three lines was critically examined on the outside, and the 72-inch (which is practically a storm-water sewer) was traversed its entire length inside and especial attention given to the contrast in structure where the brick sewer stops and the concrete pipe begins. The smoothness in flow in the concrete pipe was a marked contrast with that in the brick sewer.

The sewage had been running through these extensions fifteen days and the entire work was free from leaks, seepage, or even surface moisture. Taken as a whole, the pipe in the work varied in age from forty-five days to sixty-seven days.

Three other kinds of sewer construction to be witnessed in St. Joseph were inspected in the afternoon. The party first viewed the Grand avenue sewer, which is being extended by the concrete block method. Then they viewed the wokr on the Mitchell avenue sewer, which is being extended by the non-reinforced monolithic concrete method of construction. The sewer work in South St. Joseph was visited where the reinforced monolithic concrete method of construction is being employed.

The gentlemen of the party united in the following expression of opinion regarding the work:

The undersigned have this day viewed the sewer extensions made by the Jackson Cement Sewer Pipe Company for the Union Terminal Railway Company, and certify for the benefit of engineers who have not had the opportunity of seeing the construction that it shows rigidity of construction, smoothness of finish, and unleaking joints.

The work is all on cross-timbers and the entire structure—top, bottom and sides, is in view.

Studebaker's Automobile Plant.

For several years the Studebakers have closely wateched the development and progress of the manufacturing of automobiles, and for this purpose they have employed expert engineers, who have been sent to various points in Europe and to the important centers of the United States, and it has been their constant study to watch the progress of mechanical genius in this line.

The result of this constant and careful investigation has culminated in the Studebakers investing more than a quarter of a million dollars cash in the Garford Company, of Cleveland and Elyria, O. The Garford Company is, and has been for several years, recognized throughout the automobile world as builders of the best automobile engines, chassis and parts complete in detail, and they have been furnishing their product to a large number of the leading automobile manufacturers. This organization's product is based upon the improved French, German and American ideas combined.

The plants at Cleveland and Elyria, O., will be continued as the Garford Company, and the splendid facilities will be largely increased to meet the new demands upon them.

Street-Repair and Cleaning Machinery.

The J. H. Strain Company, 12 Elm street, New York city, has rapidly developed an excellent business in road rollers and scarifiers, scrapers, sweepers and plows. Advance sheets of a new catalogue of this line of their apparatus have been received and they describe and illustrate single and double cylinder steam road rollers, the Torpedo scarifier, the improved Barnard Castle line of road and pavement scrapers and street sweepers, machine and push brooms, gutter plows, etc.

The Torpedo scarifier is a new design, intended to be drawn by a road roller. It has four wheels of equal size to carry it, and its weight is used to hold the picks in the roadway. The scarifier is better than the old picks on the wheels of the road roller because it does its work more thoroughly at the surface and does not cut through and disturb the compacted base beneath.

The pressure on the blades or teeth of the Barnard Castle road and pavement scraper is regulated by the driver, and it is possible to use it on pavements of all kinds as well as on roads, to remove any amount of dirt, from the lightest ac-

cumulation on an asphalt pavement to a considerable depth of mud or snow. It will clean from 6,000 to 8,000 yards an hour, more than a hundred men can scrape with hand hoes. The Barnard Castle street sweepers are too well known to need description. Mr. Strain supplies brooms for them as well as for other street-sweeping machines, and also push brooms for hand work.

The gutter plow is a most convenient piece of apparatus for a street-cleaning department. It is indispensable for cleaning gutters of snow, and will handle any depth that the horses can travel through.

Another convenient piece of apparatus is a two-wheeled road scraper which can be worked up close to the curb and will handle snow and refuse as well as shape up and grade macadamized and country roads.

The catalogue can be obtained on application to the J. H. Strain Company, 12 Elm street, New York.

The Decarie Incinerator at Duluth, Minn.

The city of Duluth has recently installed a garbage incinerator which was constructed by the Decarie Manufacturing Co., of Minneapolis, Minn. The quality of the work done is best shown by the following from the report of the garbage committee of the City Council, dated Feb. 10, 1906:

The contract awarded to the Decarie Manufacturing Company for the construction of a garbage incinerator has been completed. The plant has been tested as to efficiency and capacity and has fully complied with all the conditions required in the contract, to the complete satisfaction and approval of the commissioner of health and your committee. We find that the Decarie Manufacturing Company has added many valuable improvements and conveniences, at a cost of several hundred dollars, not called for in the contract.

Upon careful inspection of the plant and its workings we recommend that the same be acecpted and paid for according to the terms of the contract.

Dr. D. D. Murray, the city health commissioner, adds the following in a personal letter:

In reply to your inquiry, we are pleased to state that the garbage incinerator which you have recently installed at Thirteenth avenue West and Railroad street for the city of Duluth has proved a great success in every way.

It works perfectly, incinerating all material dumped into it, such as kitchen garbage, decayed vegetables, dead animals, fish, combustible waste, stable refuse, etc., with ease and without emitting from the incinerators or stack any noxious odors or gases whatever.

It is absolutely sanitary. The combustion is complete, only about forty-five pounds of ashes being obtained from each ton of material incinerated.

The plant is situated very close to the business center of our city, and not one complaint has been made as to its location.

Only a white, dry, odorless vapor emits from the stack.

The cost of operation is about 24 cents per ton, including labor and fuel.

The Crouch Block and Post Molds.

Mr. E. E. Crouch, Oakland, Kan., is putting on the market a concrete building-block mold which he sells for $10, including two face plates, one plain and one rock-faced. He turns the mold with the completed block over upon a sand pallet and removes the mold from the newly made block rather than removing the block from the mold. It is claimed that one man with one mold and one mixing trough can make from 75 to 150 blocks a day, according to the size of mold used and stone produced. The standard sizes of mold make blocks 8x9x18, 8x10x20 and 8x12x24, the price of each size being the same. Hollow and solid blocks, corner-stones, half or other fractional sizes can be made. With the mold is given a special process of making the blocks non-absorbent. The small-size block lays one square foot of wall and, Mr. Crouch says, costs 7 cents to make, including labor and material.

Mr. Crouch also has a cement post mold. Four No. 8 wires are used in the corners of the post, running its full length. Wires running crosswise through the mold provide for holes through the post that are used for fastening the fence wires. The mortar is well packed into the mold and smoothed with a trowel. The form is then turned over on a bed of sand, unfastened and removed. The post should be left thirty days to cure. It is said that one man can make from 50 to 100 posts a day, at an estimated cost of 8 cents each. Address E. E. Crouch, Oakland, Kan., for further particulars.

Trade Publications.

The Sanitary Engineering Company, 237 Broadway, New York, issues a booklet descriptive of its garbage, refuse and night-soil crematories, and illustrates it with pictures and data regarding crematories at Ft. Riley and Ft. Leavenworth, Kan., and Ft. McKinley, Me., with a list of many others in successful operation.

The St. Louis Expanded Metal Fireproofing Company sends a catalogue of metalloid sidewalk, showing methods of making reinforced concrete sidewalk blocks and laying them.

Bulletin No. 2 of the I. P. Morris Co.,

Philadelphia, Pa., lists turbines and centrifugal pumps.

The E. J. Winslow Company, Chicago, Ill., issues a booklet descriptive of the use of its waterproof hydrolithic coating and basement construction, with illustrations of buildings in which it has been used.

The Clipper Lawn Mower Co., Dixon, Ill., issues some circulars regarding its lawn mowers and the advantages they possess. They also make the Clipper marine gasoline engine of 2 to 8 horse power.

The Miles concrete building-block machine is fully described and illustrated in a booklet issued by the P. B. Miles Manufacturing Co., Jackson, Mich.

E. C. Hodges, Bloomington, Ill., issues a circular descriptive of his patent sanitary concrete foundation for houses.

H. W. Clark, Mattoon, Ill., the maker of the well-known Clark meter box and other water-works appliances, issues a circular descriptive of his manufactures, which he will send on application.

Trade Notes.

ASPHALT.

Findlay, O.—A vein of asphalt is reported to have been found in Amanda tp.

BRICK.

Brazil, Ind.—The Excelsior Clay Co. has reorganized and will remodel and extend to make paving brick, sewer pipe, etc., on a large scale. Capital stock, $50,000. Geo. and Mary Brandenberg, W. H. Selders, J. C. Kidd, John V. McGregor are directors.

Des Moines, Ia.—The Flint Brick Co. will enlarge and improve its plant to make 1,500,000 paving blocks a month.

Muscatine, Ia.—A sewer-pipe factory is projected.

Milwaukee, Wis.—J. H. Radke, Alom Place and L. A. Thompson have engaged in the manufacture of brick from slag, with a proposed capacity of 40,000 a day.

CEMENT.

The Alma Portland Cement Co., Wellston, O., will furnish over 50,000 barrels of cement for the Columbus (O.) sewage disposal work.

Owingsville, Ky. — Eastern capitalists have bought land for $12,000 from Mrs. R. A. Bohannon and Mr. Patrick in Perry county, on which to locate a cement plant.

Mason City, Ia.—The proposed Portland cement factory will have a capacity of 25 tons a day. J. A. Cruikshank, of Bellefontaine, O., is interested and is also testing deposits near Des Moines. The Mason City plant has been contracted for. J. L. Ballinger and O. H. Sowdry are interested.

Cement City, Wash.—The new cement plant is promised to be ready April 1, with capacity of 3,000 barrels a day.

Bay City, Mich.—The Hecla cement plant will soon resume operations under new management.

Elk Rapids, Mich.—The cement plant is about to resume operations. A new rotary kiln will be added.

Leeds, Ala.—A company with J. Ross Hanahan, Charleston, S. C., president, and Frederick H. Lewis manager, both of the Standard Portland Cement Co., has purchased land for a large cement factory. The capital will be $500,000 and the plant will employ 125 men. Work has begun on a spur track to the location.

Ragland, Ala.—A company headed by Charles Adams, of Philadelphia, Pa., is reported to be preparing for the erection of a cement plant on the favorable report of S. S. Evans, of Cedartown, Ga. Ragland is a small station in St. Clair county, about 30 miles east of Birmingham.

Martinsburg, W. Va.—The American Standard Cement, Lime and Stone Co. has been incorporated with $500,000 capital to manufacture Portland cement and lime.

Portage, Wis.—F. H. Merrill is secretary of the Wisconsin Portland Cement Co., which expects to build a 1,000-barrel plant at Lake Ennis, Wis., 12 miles distant.

Hidalgo, Nuevo Leon, Mex.—The H. S. Spackman Engineering Co., Philadelphia, Pa., is preparing plans for a new 1,000-barrel cement plant. Contracts are now being let.

Erie, Pa.—O. C. Thayer & Sons have made a contract with the U. S. Government to furnish 4,000 barrels of Atlas Portland cement for the new pier at Erie.

Mellette, S .D.—Geo. Niemeyer, of Groton, S. D., will add to his Groton cement business a branch at this place.

Brandon, Man.—Bids are asked April 12 for 5,000 to 7,000 barrels of cement. W. H. Shillinglaw, cy. engr.

Glendive, Mont.—Sealed proposals will be received at the office of the U. S. Reclamation Service until 10 o'clock a. m. April 12 for furnishing from 8,000 to 12,500 barrels of Portland cement, f. o. b. cars at bidder's mills. Particulars may be obtained by application to the Chief Engineer of the Reclamation Service, Washington, D. C., or to the Project Engineer, Glendive, Mont.

Alexander Graham, of Ottawa, Canada, has contracted to build a large government building in Ottawa entirely of concrete. Mr. Graham has placed his order for concrete machines with the Hayden Automatic and Equipment Co., of 26 Cortlandt st., New York. The work on this building has been delayed owing to the severe weather of the past winter.

The Haworth Stone and Building Co., of Haworth, N. J., has recently contracted to build an entire concrete village, including a clubhouse and about fifty bungalows. The officers of this company are conected with the Franklin Society of New York city. These structures will be built of concrete blocks made on the Hayden concrete block machine, which has just been bought from the Hayden Automatic and Equipment Co., of 26 Cortlandt st., New York. The architect is Mr. Fred Robbins, Jr., of New York, who is also connected with the Franklin Society.

The Queens County Cement Concrete Construction Co. has recently undertaken to improve the real estate in Richmond Hill, L. I., by erecting on its property a number of concrete block dwellings. Mr. Martin Schimand, the president of the company, who has had a wide experience in contracting and building, has recently bought from the Hayden Automatic and Equipment Co., of 26 Cortlandt st., New York, a Hayden block machine. It is the purpose of the company not only to erect its own buildings with blocks made on this machine, but to sell concrete blocks which it makes.

T. L. Shaffer, of Independence, Kan., has organized the American Concrete Co., for the manufacture of concrete blocks and is preparing for the erection of a complete plant. Mr. Shaffer will be the superintendent of this new enterprise. The company will use a Normandin block machine, made by the Cement Machinery Co., Jackson, Mich. A concrete mixer, capacity 100 cubic yards a day, is part of the equipment.

LIGHTING.

The Siche Gas Co., of Plainfield, N. J., has been incorporated to construct machinery and appliances for making gas. Capital, $100,000. Incorporators: Lewis R. Arnett, Wm. L. Perrin and Sidney T. Perrin, all of Plainfield.

MISCELLANEOUS.

The city of Schenectady, N. Y., will receive bids until 2 p. m., April 9, for furnishing and erecting suitable signs designating names of streets, according to instructions of L. B. Sebring, cy. engr.

PURCHASE OF MATERIALS.

Portsmouth, Va.—Special.—C. J. Bright, 609 Cook street, writes that he is in the market for cement and crushed stone.

St. Johns, Mich.—Special.—H. Palmer, desires to purchase cement and bridge machinery and tools and excavating materials and machinery.

Wahpeton, N. D.—Special.—F. A. Hancock desires to purchase an elevator for hoisting brick and mortar on buildings.

Marmosa, Ont., Canada. — Special.—Henry Leal is in the market for machinery and tools for cement work of all kinds.

Penns Grove, N. J.—Special.—Eli D. Strimple desires to purchase machinery and tools for sidewalk construction and cement block making.

Houston, Tex.—Special.—L. Kaashock advises us that he desires to purchase cement block machinery, paving tampers and a concrete mixer.

Newark, N. J.—Special.—C. L. Higginbotham, 452 Broad st., desires price lists of concrete block machines, and catalogues and cuts of buildings built of concrete blocks.

Normal, Ill.—Special.—F. P. VanHook desires to purchase machinery for crushing and reducing phosphate and lime rock for the New York and St. Louis Mining and Mfg. Co.

Kelowna, B. C.—Special.—Geo. Patterson desires to purchase cement block machines.

Eagle Bend, Minn. — Special. — Nels Loitved advises us that he is in the market for a cement brick machine, and also a cement block machine.

Pocatello, Ida.—Special.—W. A. Samms is interested in purchasing cement block machinery, sewer and paving tools and machinery.

Greeley, Col.—Max Denbach, 424 8th ave., is in the market for a face-down cement block machine or mold box, size 8x8x16 or 18, rock or plain face only.

Charles City, Ia.—Special.—Potter & Mark are in the market for a concrete mixer, hoisting engine, small derrick and tools for building steel elevators.

Milwaukee, Wis.—Special.—H. C. Roeming, 121 12th st., advises us that he desires to purchase cement building block, cement brick and street paving machinery and tools.

Altoona, Pa.—Special.—D. W. Dillman, 49 Altoona Trust Bldg., advises us that he desires to purchase concrete mixers and sewer and inlet cleaners.

Troy, O.—Special.—W. Walter Shilling, architect, 2d floor, northeast corner Main and Cherry sts., is in the market for steel concrete.

Grand Junction, Col.—Special.—Chas. W. Haskell, cy. engr., desires to purchase steam and gasoline pumping plants for irrigation.

Montezuma, Ind.—Special.—W. E. Ireland desires to purchase wheel scrapers and supplies.

Anaconda, Mont.—Special.—N. Knudsen, A. C. M. Co., Water Dept., desires to purchase cement machinery and tools.

Emmetsburg, Ia.—Henry Kneer wants to find power machinery for making cement sewer pipe.

Piqua, O. — Special.—Harry Fuorman, 411 S. Wayne st., advises us that he desires circulars and prices of cement tools and molds.

St. Louis, Mo.—Special.—"Asphalt Rollers," care MUNICIPAL ENGINEERING Co., Indianapolis, Ind., desires to purchase two second-hand steam street asphalt rollers in first-class condition.

Eagle Bend, Minn. — Special. — Nels Loitved advises us that he is in the market for good Portland cement.

Frostburg, Md. — Special. — Whetstone Bros., contractors and builders, are in the market for insulating damp-proof 3-ply felt.

Charles City, Ia. — Special.—Potter & Mark are in the market for cement, stone, brick, iron, terra cotta, marble, tile floors, reinforced concrete, etc.

South Omaha, Neb.—Special.—Geo. W. Roberts, asst. cy. engr., desires to purchase materials for concrete sewer construction.

Kingston, N. Y.—Special.—DeNallo & Klingberg, 6 St. James Court, are in the market for cement, brick and pipes.

Baltimore, Md. — Special.—F. Gould, Box 548, wishes waterproof paint suitable for use on stucco or cement houses.

Kelowna, B. C.—Special.—Geo. Patterson desires to purchase cement, lime and plaster.

Montezuma, Ind.—Special.—W. E. Ireland desires to purchase cement.

Anaconda, Mont.—Special.—W. Knudsen, A. C. M. Co., desires to purchase cement and sewer pipe.

Huntington, Pa.—Special.—The C. H. Miller Hardware Co. desires information regarding Lafarge non-staining cement. They also desire names of manufacturers of other non-staining cement.

Houston, Tex. — Special.—L. Kasshook desires to purchase cement.

Greenville, Miss. — Special. — K. C. Thompson & Co., contractors and builders, advise us that they are establishing a branch plant at Yazoo City, Miss., for the manufacture of concrete building blocks, sills, caps, posts, etc., and will do concrete construction work of all kinds. K. C. Thompson is in charge. They are also in the market for cement for both places. They use the automatic machines made at Jackson, Mich. Are now erecting an Elks Club building in Greenville.

Ogdensburg, N. Y.—Special.—Geo. A. Tate, cy. engr., 141 N. Water st., advises us that he is in the market for cement, tile, I-beams and bridge work.

Portsmouth, Va.—Special.—C. J. Bright, 609 Cook street, writes that he is in the market for tools for cement work.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Topeka, Kan.—C. A. Proctor recommends a $10,000 municipal asphalt paving plant.

Allegheny, Pa.—Director E. J. McIlvain will recommend bond issues for street paving.

Houma, La.—Bids are wanted April 11 for two latest improved road machines. Chas. V. Moore, special road comr.

The Crockett Paving Co., of Birmingham, Ala., has been incorporated by F. L. and David Crockett and W. G. Mitchell, with capital of $10,000.

The Arkansas Paving and Construction Co. has been incorporated at Colorado Springs, Col., by Jas. M. Parker, E. A. Saiderlin and Henry C. Hall.

North Yakima, Wash.—The Central Improvement Club has been organized to secure the paving of the business section of the city and other improvements.

By typographical error it was stated in the March number that the Union Asphalt Company of Indianapolis was prepared to lay asphalt at 52 a yard, instead of $2, which was the amount written.

The Colorado Westrumite Co. has been incorporated by C. R. McGee, Robt. Jones and F. W. Downs, of Colorado Springs, Col., to develop the use of Westrumite on Colorado streets.

CONTEMPLATED WORK.

Avalon, N. J.—Council has asked for bids on 3 mis. of cement walks.

Athens, Tenn.—Bonds for $200,000 for county roads were voted for on March 11.

Virginia, Minn.—Paving of Chestnut st. is strongly urged.

Bridgeport, Conn.—Grading and macadamizing of N. Main st. will soon begin.

Topeka, Kan.—Paving of Kansas ave. is agitated.

LeMars, Ia.—Brick paving in alleys is wanted.

Indianapolis, Ind.—Bids will soon be asked for new asphalt repair contract.

Topeka, Kan.—Bids will be asked soon for brick paving to cost about $95,000.

San Francisco, Cal.—$250,000 will be spent on paving streets in near future.

Bluffton, O.—Town Council has decided to pave Church st.

Jamestown, N. Y.—Council has been petitioned to pave Lakeview ave.

Bradford, Pa. — Congress st. will be paved at estimated cost of $20,000.

Atchison, Kan.—Four miles of macadam road will be built by county.

Youngstown, O.—Property owners are asking for paving of S. Main st.

Greenville, Tex.—Co| comrs. have voted to pave county's part of public square.

Portsmouth, O. — Boulevard for East End on Jackson st. is agitated.

Dennison, Tex.—Paving of Main st. is agitated.

Chicago, Ill.—Sheridan drive will be paved with bitulithic. North Park Board.

New Orleans, La.—Citizens have agreed to pay for paving of St. Charles ave. from Louisiana to Carrollton ave.

Goshen, Ind.—Paving of Madison street is urged.

Youngstown, O., has purchased portable asphalt repair apparatus at Chattanooga, Tenn.

Chicago, Ill.—Woodlawn ave. between 61st and 67th sts. will be paved with bitulithic.

Lorain, O.—Council has passed resolution to pave Everett st. with asphalt, brick or creosoted block.

Houston, Tex.—Asphalt is recommended by property holders for Main st. pavement.

Olathe, Kan.—Brick paving of one and a half miles of street is proposed for this summer.

Detroit, Mich.—The amounts asked for repaving and repairing streets this year foot up nearly $1,250,000.

Hamilton, O.—Bids will be asked soon for paving 4th, Dayton, N. Seventh and Henry sts.

St. Joseph, Mo.—Paving of Twentieth st. with macadam and brick gutters is ordered by B. P. W.

Omaha, Neb.—Nearly enough petitioners to secure paving of Hamilton st. from 25th to 40th sts. have been secured.

Dayton, O.—Williams st. from 5th st. to bridge has been ordered paved with brick.

Dallas, Tex.—Ervay-st. property owners have designated bitulithic as the pavement for that street.

Lincoln, Neb.—Another attempt will be made to pave S. 14th st. from A to South st. 30 ft. wide.

Penn Yan, N. Y.—City has voted to pave Jacob st. from Main st. to railroad, at cost of $15,000.

Wheaton, Ill.—Nine miles of macadam paving has been ordered to be completed this year, at a cost of $225,000.

St. Louis, Mo.—Public hearings regarding paving on 38 streets will be given April 6.

Ardmore, Tex. — An election will be held April 7 to vote on $120,000 bonds for municipal improvements.

Dallas, Tex.—A paving district on parts of Lamar and Alexander sts. and Cockrell ave. has been created.

Hattiesburg, Miss.—Bids will be called for at once for street and sewer work under bond issue already provided for.

Gainesville, Tex. — City officials have visited other cities to get ideas regarding proposed paving.

Youngstown, O. — Roads about Wick Park will be macadamized this summer at cost of $44,000.

Nevada City, Cal.—Macadam road from this city to Washington is proposed. Estimated cost, $12,000.

Oakland, Cal.—B. P. W. authorized expenditure of $15,000 for extending East Side boulevard on Lake Merritt.

Cicero, Ind.—Town Board has passed resolution favoring paving of several main streets.

Barton Heights, Va.—Will vote April 17 on question of issuing $10,000 bonds for street improvements.

Crookston, Minn. — Resolution passed by Council to pave Ash st. from intersection of Fletcher to Houston ave.

Delaware, O.—Paving William st. from Sandusky to Curtis has been petitioned for.

Toledo, O.—Extension of Summit st. across Swan creek is being agitated by Summit St. Improvement Association.

Grand Rapids, Mich.—B. P. W. has approved estimate for paving W. Leonard st. from River to Alpine ave.

Harrisburg, Pa.—City engr. is preparing plans and specifications for $40,000 of paving.

Sheridan, Ind. — Ordinance has been passed for paving and constructing sidewalks on Main st. Estimated cost, $35,000.

Bedford, Ind.—About 14,000 sq. yds. of brick or bitulithic paving will be done this spring.

Springfield, O.—Cy. Engr. W. H. Siensburg is preparing estimates for paving Center st. and Grape alley.

Indianapolis, Ind.—Ritter ave. will be paved from Washington st. to C., H. & D. tracks.

Holly Beach, N. J.—Brick paving on concrete is proposed for Pacific ave. H. S. Hewitt, boro clk.

Bloomington, Ill.—Board of Local Imp. has passed a resolution for paving Orleans, S. Market and W. Patton sts.

Memphis, Tenn.—Business Men's Club has appointed a committee to devise plan for raising funds to pave entire city.

South Manchester, Conn.—Local board of selectment will soon ask bids for macadamizing Middle turnpike.

Altoona, Pa. — Ordinances for paving 8th, 7th and 5th aves. have been introduced in Council.

Pueblo, Col.—S. Union ave., B, C and D sts., Main and Festivo sts. will be paved with bitulithic.

Moline, Ill.—Ordinance has been introduced to pave with asphalt 12th ave. from 15th to 19th sts.

Birmingham, Ala.—Ordinance to provide $95,000 bond issue for paving business streets has been introduced.

Evansville, Ind.—Resolution has been passed by B. P. W. for paving several streets with brick.

Elgin, Ill.—Bids may be called for in April for paving National st. with brick on concrete. Henry Dakin, cy. engr.

Wichita, Kan.—Cy. Engr. Brown estimates Topeka ave. paving to require 3,557 sq. yds. of brick, at cost of $7,145.

Augusta, Ga.—Reynolds and Seventh streets will be paved with brick with granite curbs.

Reading, Pa.—Washington township residents are petitioning for macadam roads, in all about 2 2-3 miles.

El Paso, Tex.—City officials have visited other cities to get ideas about paving, having $175,000 available for that purpose.

Atlantic City, N. J.—Seven members of a paving investigating committee have visited cities to select a pavement for Atlantic ave.

Danville, Ind.—It is proposed to pave streets having interurban tracks with brick and others with gravel or broken stone, and cement or brick gutters.

Gibson, Ill.—Paving ordinance has been passed for brick paving on Sangamon ave. in five sections, estimates aggregating about $38,000.

Wichita, Kan.—A number of cement sidewalk petitions have been presented to Council. Work will be permitted to begin April 1.

Fond du Lac, Wis.—Paving of 4th st. is contemplated.

Terre Haute, Ind.—Vitrified brick pavement on concrete foundation, costing about $41,000, has been ordered for S. 8th st. from Ohio to Hulman.

Youngstown, O.—The Board of Public Service recommends paving Elm st. from Park st. to city limits and sidewalks on N. Watt and Washington sts.

Galesburg, Ill.—Money for extension of W. Main-st. brick pavement to Linwood Cemetery has been raised, the city paying $1,500.

Terre Haute, Ind.—Brick paving on natural foundation has been ordered for N. 8th st. from Cherry st. to Lafayette ave. by B. P. W.

Dayton, O.—Clerk was ordered to advertise for bids for paving and curbing aproaches to new Herman-ave. bridge, to cost $1,155.

Minneapolis, Minn. — Council has ordered paving Nicollet ave. from Washington to 10th st. with creosoted wooden blocks. Estimated cost, $50,086.

Atlantic City, N. J. — Ordinance has passed Council for asphalt paving on Pacific ave. Estimated cost, $25,000. J. W. Hackney, cy. engr.

Pittsburg, Pa.—Plans are being prepared for State road between Pittsburg and Phialdelphia. Estimated cost, $2,500,000.

Birmingham, Ala.—Street and lighting committee recommends issue of $42,000 bonds for paving portions of 19th and 20th sts. and 3d ave.

Findlay, O.—City Council has passed an ordinance for paving Center st. at cost of $9,120. Paving of E. Lincoln st., at cost of $18,233, is also contemplated.

Kokomo, Ind.—B. P. W. will soon ask for bids for paving Jackson and Buckeye sts. with macadam. A. C. Mann, cy. engr.

Chardon, O.—L. F. Phelps, cy. engr., has been ordered to prepare plans and specifications for paving part of North and South sts.

Sacramento, Cal. — City surveyor has been directed to make specifications for basalt block pavement on concrete for Front st., costing $75,000.

Wilmington, Del.—New bids will probably be called for on macadamizing road from Market-st. bridge over Christiana creek south to city line. Levy Court Com.

Streator, Ill.—Ordinances are reported passed for paving of S. Illinois, Sterling, N. Wasson, W. Stanton, 2d and 9th sts., at estimated cost of $33,932.

Davenport, Ia.—Council rejected bids of March 6 for paving Brady, Scott, Ripley, High and 18th sts. New bids will probably be called for.

Birmingham, Ala.—Ordinances have been adopted for sidewalks on Nineteenth and Twentieth streets from I avenue to city limits.

Phoebus, Va.—Special.—John C. Turner, recorder, says this city contemplates awarding a paving contract about June 1 for about $35,000 of paving. L. P. Furness, mayor.

Seattle, Wash.—Sandstone paving has been agreed upon for Marion st., 1st to 2d, $4,550 estimated cost; Marion st., 9th to Terry, $3,230; Spring st., $4,650; Seneca st., $4,650.

Cairo, Ill.—Officers of Cairo and Thebes Railroad ask co-operation of Council in making necessary improvements, such as

paving, filling and sewering in vicinity of their passenger and freight station.

Steubenville, O. — The LaBelle View Land Co. petitions for cement sidewalks on Belleview and South Bend boulevards and Reserve ave., and brick paving on Reserve ave.

St. Paul, Minn.—Bids for macadamizing Point Douglas road were higher than the $8,000 appropriation and will probably be rejected. Bids for macadamizing Como avenue were likewise rejected and it will be readvertised.

Baltimore, Md.—Bids will shortly be asked for paving Erdman ave., the first under the new $2,000,000 paving loan for the "annex." Twenty-fifth st. will follow, then 26th, 27th and parts of Charles and Calvert sts., and others.

Walla Walla, Wash.—Plans for paving have been completed: Dist. No. 20, 14,339 yds. at $37,025; No. 21, 54,388 yds. at $135,665; No. 22, 44,285 yds. at $37,128, and No. 23, 695 yds. at $1,175; a total of $211,534.

Mansfield, O.—City Council has passed resolutions for improving parts of Wood, W. 4th, Harker, Cedar, E. 3d, Orange, Blanch and W. Diamond sts., Penn, Stewart, Chester and Wise aves. and Plumb alley.

St. Louis, Mo.—Council has passed bill authorizing construction of speedway drive in Forest Park; also resolution for paving district bounded by Franklin ave., Market and Third sts. and Jefferson ave. has passed.

Brazil, Ind.—City Council has ordered 13 streets improved at estimated cost of over $100,000. They include 5 mis. of sidewalks and over 2 mis. of brick pavements, and elevation of Vandalia tracks and viaduct. The contracts will be let on or about April 17.

St. Joseph, Mo.—Special.—City Engineer W. H. Floyd, Jr., says that ordinances have been prepared for paving 11 streets with brick, 7 miles in length, 150,000 sq. yds. area. Other work is to follow.

Salt Lake City, Utah.—The Salt Lake Security and Trust Co. has opened a new thoroughfare to be asphalted with 25-ft. roadway; also sidewalks. It is 330 ft. long from Second East st., between Second and Third South sts.

York, Pa.—Bills have been introduced in Council ordering paving of N. Duke and N. Penn sts. out of the money from 3 per cent. tax on street-railway receipts. Other bills authorize paving of S. Queen, E. King, S. Pine, E. Prospect, E. Market and E. Philadelphia sts.

Tacoma, Wash.—Petitions have been received for paving parts of South A, South 20th, South 19th, South 22d, South 23d, South 24th and South 25th sts. with asphalt and sandstone on the hills. East C st from Puyallup ave. to South 26th st. will be graded and graveled, and plank sidewalks constructed. Resolutions have been introduced for paving 6th ave. from C to Warner st. with asphalt, brick gutters and cement curb, and for grading and sidewalks on East K, South 43d, N and East C sts.

Rochester, N. Y.—Hearings on the following paving ordinances were held March 27 by City Council: Erie street, brick, estimated cost, $4,000; Dean street, brick, $4,500; Brown street, brick or stone, $33,500; State street, cement sidewalks, $1,200; Fifth street, brick, $15,000; Sixth street, brick, $15,000; South street, brick, $13,000; Cuba Place, brick, $6,000; Herald street, brick, $7,700; Myrtle street, brick or asphalt, $15,500; Barnum street, brick, $19,000; St. Paul street, Medina stone, $33,000; Richmond street, asphalt, $10,500; Whitney street, brick or asphalt, $29,600; Goodman street, brick, $50,000; and Boardman street, brick, estimated cost $18,000.

CONTRACTS TO BE LET.

Valparaiso, Ind.—Bids will be received April 2 for constructing 15,070 ft. of gravel road in Union tp. Co. comrs.

Brookville, Ind.—Bids will be received April 2 for constructing macadam road in Posey tp. Co. comrs.

Newburg, O. — Bids will be received April 4 for grading Rice ave. W. H. Yantzen, clk. B. P. S.

Stevens Point, Wis.—Bids will be received April 7 for improving S. 3d and Water sts. L. J. N. Marat, chmn. B. P. W.

Auburn, N. Y.—Bids will be received April 3 for paving Owasco st. with asphalt. J. S. Hanlon, cy. clk.

Green Bay, Wis.—Bids will be received April 14 for 2 mis. of asphalt paving. W. W. Reed, cy. engr.

San Francisco, Cal.—Bids will be received April 9 for reconstructing Geary st. road. Thos. P. Woodward, cy. engr.

Mooresville, Ind.—Bids will be received April 3 for constructing half mile cement sidewalk. Clk. Town Bd.

Bismarck, N. D.—Bids will be received April 6 for constructing cement sidewalk at Ft. Lincoln. R. H. Leavitt, Q. M.

Webb City, Mo.—Bids are asked April 2 for grading and graveling Joplin st. W. E. Smith, cy. engr.

Findlay, O.—Bids are asked at 1:30 p. m. April 2, for building stone road. Eli W. Pepple, tp. clk.

Ittabena, Miss.—Bids are wanted April 3 for 4 mis. of cement sidewalks. H. H. Nabors, mayor.

LaCrosse, Wis.—Bids are wanted April 17 for 9,500 sq. yds. granite top macadam and 2,000 sq. yds. brick pavement.

Marion, O.—It is reported that bids will be received April 14 for paving Franklin and Bradford streets.

Rensselaer, Ind.—Bids are wanted at noon, April 16 for stone roads in Marion, Jordan and Carpenter townships, 20,800 feet long. County Commissioners.

Valparaiso, Ind.—Bids are wanted at 10 a. m. April 9 for gravel roads in Portage township 9,193 feet long. County Commissioners.

Burlington, Ia.—Bids are wanted April 2 for 15,000 sq. yds. brick pavement and 6,500 ft. concrete curb. Wm. Steyh, cy. engr.

Rensselaer, Ind.—Bids are wanted April 16 for 18,000 ft. of stone road in Marion, Jordan and Carpenter tps. Jas. N. Leatherman, co. aud.

Owensboro, Ky.—Bids are wanted April 3 for 21,865 ft. of macadam or gravel roads. H. M. Talbott, engr., 1301 Triplet st.

South Bend, Ind. — Bids are wanted April 3 for 10,000 sq. yds. of asphalt pavement and 21,000 sq. yds. of brick pavement. Bd. Pub. Wks.

Hebron, Conn.—Bids are asked April 5 for improving four sections of gravel and gravel telford roads. E. T. Smith, chmn. bd. selectmen.

Paris, Tex.—Bids are asked at 4 p. m. April 19 for 13,000 sq. yds. of brick paving. T. C. Bishop, mayor; H. M. Price, cy. engr.

Opelousas, La.—Bids will be received at noon April 10 for 14,000 linear ft. of

5-ft. cement sidewalk. B. A. Littell, mayor.

Washington, Ind. — Bids are wanted April 2, at 2 p. m., for construction of 7,860 ft. of gravel road. Thos. Nugent, co. aud.

Green Bay, Wis.—Bids are wanted April 2, at 10 a. m., for paving three streets with asphalt — viz., Washington, Main and Pine sts.—in three contracts.

Lebanon, O. — Bids will be received April 6 for constructing 30,000 sq. ft. of cement sidewalk. R. B. Corwin, vil. clk.

Holyoke, Mass.—Bids will be received April 6 for furnishing 10,000 gallons or more of sidewalk composition. M. F. Walsh, chmn. B. P. W.

Peru, Ind.—Bids will be received April 7 for about 11 mls. of cement sidewalks. Specifications may be obtained of the Oakdale Improvement Co., Peru.

Greensburg, Ind.—Bids will be received April 2 for constructing 2¾ mls. macadam road in Washington tp. Frank E. Ryan, co. aud.

Paoli, Ind.—Bids will be received April 4 for constructing 6,875 ft. of road in French Lick tp. and 5,637 ft. in Orleans tp. Co. comrs.

South Bend, Ind.—Bids will be received April 3 for 10,000 sq. yds. asphalt paving and 21,000 sq. yds. brick paving. A. J. Hammond, cy. engr.

LaCrosse, Wis.—Bids will be received April 17 for macadamizing Jackson st. H. J. Beckwith, pres. B. P. W. Estimated cost, $25,000.

Watertown, Wis.—Bids will be received April 10 for 14,443 sq. yds. brick paving and 7,166 sq. yads. macadam road. E. B. Parsons, cy. engr.

Binghamton, N. Y.—Bids will be received April 9 for paving Chenango st. and Susquehanna st. with vitrified brick on concrete, about 5,000 sq. yds. in the two contracts. D. C. Herrick, cy. clk.

New York City.—Bids will be received April 4 for constructing cement sidewalks on various streets, amounting to 86,431 sq. ft., and grading a number, by Bird S. Coler, pres. Borough of Brooklyn.

Shelbyville, Ind.—It is reported that bids will be received April 7 for bitulithic pavement on several streets, the contest of citizens and Council having been compromised.

Brooklyn, N. Y.—Bids will be received April 5, at 3 p. m., for cement sidewalk on Prospect Park west, between 5th and 15th sts. Moses Herman, pres. Dept. of Parks.

Skelly Station, O.—Bids will be received at noon April 14, at residence of Jas. Wherry, for grading and macadamizing 1 1-5 mls. of Skelly Station Free turnpike.

North Branch, Mich. — Special.—Contract for construction of about 96,000 sq. ft. of cement sidewalks and cross-walks will be let about April 15. A. C. Galbraith, vil. clk.

Buffalo, N. Y.—Bids will be received at 11 a. m. April 5 for repaving Main st from Chippewa to Goodell st., except street-railway tracks; and Hughes ave., 28 ft. wide, from Jefferson to Oak Grove ave.

St. Louis, Mo.—Bids for paving Union boulevard and Bernays ave., estimated cost $7,240, and Hamilton ave., estimated cost $41,709, were rejected March 20 and new bids will be received April 6.

Plattsburg, N. Y. — Bids are wanted April 6 for paving on Bridge st. with asphalt block, cut stone paving blocks and combined curb and gutter. John Haughran, chmn. B. P. W.

Charleston, S. C. — Bids are wanted April 5 for 8,000 ft. stone curbing, hauling same and laying 9,000 sq. yds. concrete sidewalk during 1906. J. B. Heckley, supt. sts.

Madison, Ind.—Bids are wanted at 10 a. m., April 5, for 3,352 feet of macadam road on line between Madison and Hanover townships. G. F. Crozier, County Auditor.

Omaha, Neb.—Bids are wanted April 3, at 2 p. m., for construction and widening of walks during 1906 of stone, artificial stone, brick, tiling and white pine, in four districts of the city. W. H. Elbourn, cy. clk.

CONTRACTS AWARDED.

Dayton, O.—Contract for macadamizing Valley Pike was awarded to W. I. Anderson at estimated cost of $12,000.

Boone, Ia.—Magden & Shelby, of Des Moines, received contract for paving on Green, Story and W. 7th sts. for $19,619.

Sacramento, Cal.—Clark & Hennery was lowest bidder for resurfacing J street with asphalt, at $7,612.40.

St. Paul, Minn.—Jas. Forrestal was awarded contract for macadamizing on Edgerton street, at $5,000.

Salina, Kan.—Kansas Bitulithic Paving Company received contracts for bitulithic on Santa Fe avenue.

St. Paul, Minn.—Fielding & Shepley were awarded contract for paving on John street with sandstone, at $11,695.

Flint, Mich.—Timothy Lynch, Flint, was awarded contract for Detroit street brick pavement, for $9,643.

Atlantic City, N. J.—E. S. Lee was awarded contract for trap rock for street repairs, at $1.74¾ a ton.

Bay City, Mich.—Patrick Ryan will pave Belinda street at $6,348, with $3,454 for street and alley intersections and $9,802 for street railway's share.

Camden, N. J.—Barber Asphalt Company was awarded half a dozen contracts March 20 for asphalt streets, at $1.89 per square yard.

Newton, Mass. — Simpson Bros., 166 Devonshire st., Boston, Mass., received contract for laying concrete sidewalks, cross-walks, gutters, etc., for $13,535.

Davenport, Ia.—McCarthy Improvement Co., of Davenport, received contract for asphalt on Gaines st. at $1.70 and on Division st. at $1.53 per sq. yd.

Bloomington, Ill.—O. W. Dunlap has received contract for Olive st. brick paving at $1.59 per sq. yd, for brick and 58 cents per lin. ft. for granitoid curb and gutter. Elmer Folsom, cy. engr.

Birmingham, Ala.—J. L. Mullarky, Birmingham, was awarded contract for sidewalks and curbing on Twentieth, Twenty-first and Twenty-third streets from C to J avenue.

St. Paul, Minn.—Jas. Forrestal Company was awarded Edgerton street macadam paving at $7,090, but $5,000 of the work to be done, the amount of the appropriation.

Davenport, Ia.—McCarthy Improvement Company was lowest bidder on paving Fillmore street with asphalt and for paving intersections on Second street with creosoted blocks.

Bay City, Mich.—Lowest bidders for paving Garfield avenue were W. J. Meagher, about $25,000 for brick; Barber Asphalt Company, about $28,500 for Ge-

nasco asphalt, and about $27,000 for bituminous macadam; for paving Lafayette ave., W. J. Meagher, about $5,600 for brick, Barber Asphalt Company, about $5,800 for bituminous macadam.

Baltimore, Md.—Contracts have been let for paving Monument Square with creoresinate blocks at $3.48 per square yard; and Lexington street with vitrified brick at $3,434.

Wheeling, W. Va.—Jas. M. Porter will supply for the needs of the city during 1906 Globe paving brick at $8.95 a thousand; Jas. E. Wright Company, Bessemer block at $15.50 a thousand; T. Wm. Stubbs stone curb at 65 cents per lineal foot.

Augusta, Ga.—W. F. Bowe was awarded contract for Belgian block paving on Center street and on Ninth street, and general contract for curbing. A. J. Twiggs received general contract for cement sidewalks at 12 cents for walk, 14 cents for driveways and 20 cents for vitrified brick driveways.

Kalamazoo, Mich.—Low bidders on paving N. West, North, Burdick and Pitcher streets, March 12, were as follows: W. W. Hatch & Sons, Goshen, Ind., Nelsonville or Athens brick, $1.625 per square yard; Central Bitulithic Paving Company, Detroit, Mich., bitulithic on bituminous base, $2.10.

Davenport, Ia.—Lowest bidders on paving, March 6, were as follows: Barber Asphalt Company, asphalt, Scott street, $1.68; Seventh street, $1.69; Division street, $1.68; Brady street, $1.68; High street, $1.68; Eighteenth street, $1.68; Ripley street, $1.68; McCarthy Improvement Company, asphalt, Gaines street, at $1.53.

Kansas City, Mo.—Asphalt paving contracts have been awarded as follows: Parker-Washington Company, Cherry street at $1.81 a square yard; Charlotte street, $1.78; Thirty-fourth street, $1.70; Kennington street, $1.85; Campbell street, $1.65; Forest street, $1.80; Cleveland Trinidad Company, Oak street, $1.69; Roberts street, $1.90; Wabash street, $1.77; Montgall street, $1.78; Thirty-sixth street, $1.76.

Manistee, Mich.—Geo. B. Pike, city surveyor, reports that the Central Bitulithic Paving Company, Detroit, Mich., received contract for paving River, Smith, Maple and Washington streets with bitulithic on concrete, with Metropolitan block and Pioneer asphalt filler in street railway, estimated cost $38,792, all under 5-year guaranty. Nelson & Hanson, Manistee, received contract for combined curb and gutter, total $3,224,50.

Indianapolis, Ind.—Bids for cement walk on Lee street ranged from 63 to 68 cents per linear foot, J. Harry Roberts, lowest bidder; on Buchanan street from 57 to 65 cents, A. L. Neisler, lowest; on Harding street from 59 to 65 cents, J. Harry Roberts, lowest; and for cement walks and curb on Bates street from $1.12 to $1.23 for combined curb, and for stratified curb, from $1.27 to $1.38; Indianapolis Construction Company lowest bidder for both.

Rochester, N. Y.—Lowest bidders March 14 were as follows: Park avenue asphalt, Rochester Paving Company, $46,004; Park avenue, brick, Hagaman, Miller & Hagaman, $47,874; Cortland street, asphalt, Rochester Vulcanite Pavement Company, $14,009; Cortland street, Medina block, Hagaman, Miller and Hagaman, $17,664; Second street, brick, Chambers & Grady, $13,534; Third street, brick, H. B. Hooker & Son, $13,672; Fourth street, brick, Whitmore, Rauber & Vicinus, $23,314.

Bay City, Mich.—Contracts for paving were awarded March 14 as follows: Bowery street, brick, Wm. J. Meagher, $17,465.95, street and alley crossings $7,865; the street railway's share on Bowery street to H. C. Morris at $14,838.09; Twenty-third street, brick, P. Ryan, $4,082 and $1,516 for street and alley crossings; street railway's share to H. C. Morris, at $3,063.15; Broadway, brick, Hugh Campbell, $12,450 and $5,060 for street and alley crossings; street railway's share to H. C. Morris, at $10,254.75; Twelfth street, brick, Wm. J. Meagher, $1,464.

Canton, O.—Lowest bidders on paving, March 21, were as follows: W. Second street, grading curbing and crosswalks, Wise, Wise & Smith, $2,714.05 with Berea curb and $2,527.23 with sandstone curb; Wade street, grading, curbing, flagging and crosswalks, same firm; Walnut street, brick, Turnbull Bros., with Berea curb $13,287.17 and sandstone curb, $12,855.34.

Peoria, Ill.—Jas. S. Allen was awarded the paving of Persimmon street at $10,679.56, of Wisconsin street at $3,565.10, and of Spencer street at $15,905.50. A. W. Moffatt was awarded contract for hauling curb, at 3 cents a foot, Frank Hoeffner for cutting and setting curb at 9½ cents a foot, and the Peoria Stone and Marble Company will furnish the curb at 28 cents a foot.

SEWERS.

CONTEMPLATED WORK.

Mt. Gretna, Pa.—Plans have been adopted by directors of United Brethren Camp Meeting Association for a complete sewerage system.

Pleasant Valley, W. Va.—Question of building additional sewers is being agitated.

Aberdeen, S. D.—It has been voted to issue $75,000 bonds for constructing modern sewage disposal plant.

Dodge Center, Minn., is agitating sewer and water works improvement.

South Bend, Md.—Petition circulated in business district for new sewer.

Marion, O.—Council adopted resolution directing cy. engr. to make plans for sewer and necessary drains on Boone ave.

Des Moines, Ia.—Plans have been completed for big brick trunk sewer through Union Park.

Haverhill, Mass.—City Council recommends construction of sewer for Kimball, Central and Brook-st. districts.

Grand Rapids, Mich. — Bids will be asked immediately for $91,000 Hilton-st. sewer. Cy. Engr. Anderson.

Coeur d'Alene, Ida.—Plans for sewer system to cost $29,000 are ready.

Jackson, Mich., will vote $50,000 sewer bonds April 2.

Schenectady, N. Y.—Plans are being prepared for sewers in 9th and 10th wards.

Wilmington, Del.—Plans are being prepared for new sewers in various parts of city.

Los Angeles, Cal.—Ordinance has been passed for $1,100,000 bond issue for municipal improvements, including sewers and storm drains.

Belleville, Ill. — Ordinance has been passed for expenditure of $125,000 for sewer construction and paving.

Zanesville, O.—Ordinance has been adopted appropriating $78,000 for sewers in northwestern district.

Cleveland, O.—Plans have been prepared for main intercepting sewer, outlet pipes, settling basin, etc. Estimated cost, $10,000. Cy. clk.

New Britain, Conn.—Bids will soon be asked for 19,177 ft. pipe sewers, with 51 manholes and 830 cu. yds. rock excavation. Wm. H. Caldwell, ch. engr. sewer dept.

Titonka, Ia. — Will vote on sewerage question.

Crewe, Va. — Is considering sewerage system.

Peoria, Ill.—Petitions are made for sewers in 2d district.

Lorain, O.—Proposed outfall sewer will cost $11,500.

Merchantville, Pa., will vote April 17 on sewerage system.

Barberton, O.—Council has sold $9,000 bonds for sewer work.

Lorain, O.—Resolution was passed by Council for lateral sewer in Florence st.

St. Charles, Mo., voted on sewer system, to cost $80,000, March 27.

Prosser, Wash.—Council is considering bond issue for sewerage system, etc.

Salem, O.—A sewer along Buttermilk run is agitated.

Cuyahoga Falls, O.—Sewerage system is under consideration.

Columbiana, O.—Sewerage system is under consideration by village Council.

Hart, Mich.—F. F. Wetmore, Pentwater, has made plans for $6,000 worth of sewers.

Southington, Conn.—Business Men's Association is agitating sewer question.

Battle Creek, Mich.—Marshall st. sewer will be extended, at cost of $10,000.

Minneapolis, Minn.—Cy. engr. reports $147,000 available for new sewers in 1906.

Bridgeport, Conn.—About $26,500 will probably be spent for sewers this year.

Wilkesbarre, Pa. — About $20,000 will probably be expended for pipe sewers.

Minot, N. D.—Sewerage system is under consideration. S. F. Grabbe, Fargo, engr.

Peoria, Ill.—North Peoria sewer had a hearing March 26. Will cost $233,000.

Seattle, Wash.—Council will probably order sewer in 5th ave. N., costing $2,130.

Seneca Falls, N. D.—Voted March 20 to issue $68,000 bonds for sewerage. E. L. Guion, cy. clk.

Ontario, Ore.—Voted March 3 to issue $26,000 bonds for drainage system. C. T. Noe, cy. rec.

Albuquerque, N. M.—Alexander Potter, New York, will report on changes in sewer system and cost.

Belington, W. Va.—Voted March 20 to issue $20,000 bonds for sewerage and street improvements.

LaCrosse, Wis.—Plans are under consideration for sewers in eastern part of city and Hillview.

Emmetsburg, Ia. — It is proposed to build about 12,000 ft. of 24-in. cement pipe sewer for drainage.

Dallas, Tex.—Property owners ask for sewers in Ervay st. before new bitulithic pavement is laid.

Utica, N. Y.—Bill to authorize construction of storm water sewer system has passed Legislature.

Ravenna, O.—Plans for $100,000 sewerage system have been approved by State Board of Health.

Chattanooga, Tenn.—Several blocks of sewer lines in 9th ward and on Read ave. will be constructed this season.

Rochester, N. Y.—Hearings were held March 27 on Paige-st., sewer to cost $1,700, and Loomis-st. sewer, to cost $1,900.

St. Louis, Mo.—This year's work includes $250,000 expenditure for Harlem creek sewer and $200,000 for other sewers.

Youngstown, O.—Bd. Pub. Service has recommended sewers in Griffith and Thomas sts. and Crossman ave.

Ardmore, I. T.—Will vote April 7 on $35,000 school bonds, $35,000 water-works bonds and $50,000 sewerage bonds.

Medina, O.—The Board of Public Affairs has employed E. G. Bradbury, engineer, of Columbus, O., to make plans for a system of water works and sewerage, with disposal plant.

Waterloo, Ia.—Plans are in preparation for extension of E. Waterloo sewerage system, at cost of $30,000 or more.

Wichita, Kan.—Resolution calling for sewerage and drainage system was passed by Council March 13; total cost, $42,319.

Rochester, N. Y.—Sewers will be extended in Hamilton, William and West sts. and Nursery ave., 4,533 ft. in all.

Hattiesburg, Miss. — Will advertise shortly for bids on sewer system; $200,000 bond issue has been made for sewers, water and paving.

Albion, Neb.—A sewerage system to cost $5,000 to $10,000 is proposed. No engineer has yet been appointed. Jesse Graham, mayor.

Hamilton, Ont.—The proposed sewage purification plant will cost $30,000. E. G. Barrow, cy. engr.

Sapulpa, I. T.—Engineer D. B. Merry, Tulsa, has submitted plans for sewer system; total cost $44,000, present needs $21,000.

Atlanta, Ga.—Sewer to cost $14,500 is proposed for John st. and extensions of Orme st. sewer at $10,000 and 3d ward sewer at $7,000.

Burlington, Vt.—Cy. Engr. F. O. Sinclair and Aldermen Coffey, Reeves and Willard are committee to investigate cost of sewage disposal plant.

Pekin, Ill.—Special.—The 4th district sewer ordinance passed by City Council March 5 begins a $110,000 improvement.

St. Joseph, Mo.—Special.—Cy. Engr. W. H. Floyd, Jr., is preparing plans for over 20 mis. of district sewers, 10 to 30 in. drain, vitrified pipe.

New Haven, Conn.—Mayor Studley has approved order for storm overflow sewers on State and Water sts., to cost $40,000. C. W. Kelly, cy. engr.

Grundy, Ia.—Council sewer committee recommends full sewer system, costing $16,000, and special election on bond issue therefor.

New Haven, Conn.—New sewers are ordered for Castle, Bright, Atwater, Peck, Blatchley, Clinton, Chatham, Linden, Sperry and Barclay sts. and aves.; total cost, $14,028.

Waitsburg, Wash. — Plans for sewer system have been prepared by J. B. Wilson, Walla Walla, 18,930 ft. of pipe, septic tank and filter beds; total cost, $10,228. City will vote April 3 on $11,000 bonds to meet cost.

Winchendon, Mass. — McClintock & Woodfall, Boston, Mass., have filed with Citizens' Sewerage Com. report calling

for 15 acres filter beds, sludge beds, tanks, etc., and outlets, to cost about $250,000.

West Seneca, N. Y.—Plans have been submitted to the State Board of Health for approval for a sewerage system for the town. Cost estimated at $227,663. Engr. Denison Fairchild, Buffalo, N. Y.

Indianapolis, Ind.—The West Indianapolis sewer system has been adopted by Bd. Pub. Wks., and will be constructed, at cost of $170,000. B. H. Miller, cy. engr. Bids will probably be received in April.

CONTRACTS TO BE LET.

Chillicothe, O.—Bids are wanted April 3 for storm sewer. M. M. Redd, cy. engr.

West End, Ala.—Bids are wanted April 3 for building sanitary sewer. P. S. Miller, cy. engr.

Paterson, N. J.—Bids are wanted April 5 for constructing sewers. H. J. Harder, cy. engr.

Georgetown, Ky.—Bids are wanted April 11 for 4 mis. of pipe sewers. D. A. Adams, cy. clk.

New Britain, Conn.—Bids are wanted April 3 for sections E and F of city sewer system. Bd. Sewer Comrs.

Marion, O.—It is reported that bids will be received April 14 for sewer in Pennsylvania ave.

Springfield, Mo.—Bids are wanted April 3 for construction in sewer district on North Side. W. H. Schreiber, cy. engr.

Aberdeen, S. D.—Bids are wanted April 9 for $75,000 sewer bonds. F. W. Raymond, cy. clk.

Boise City, Ida.—Bids are wanted at 8 p. m. April 5 for laying 24,000 ft. of sewer pipe and appurtenances. J. A. Beal, cy. clk.

New York, N. Y.—Bids are wanted at 3 p. m. April 4 for sewers in Cedar and W. 172d sts. John F. Ahern, pres. Manhattan borough.

Salem, Mass.—Bids are wanted April 5 for two sections, 2,020 ft. 60-in. and 2,100 ft. 57-in., trunk sewer. Thos. G. Pinnock, chmn. sewerage com.

Pipestone, Minn.—Bids are wanted April 11 for 1,603 ft. 10-in. and 803 ft. 12-in. sewer and appurtenances. Cy. Council. Loweth & Wolf, cons. engrs., St. Paul, Minn.

Indianapolis, Ind.—Frank C. Mortimer, Chicago, Ill., was lowest bidder on sewage purification plant at Ft. Benj. Harrison, at $23,826, including septic tank, contact beds and filters.

Charleston, S. C.—Bids are wanted April 5 for furnishing 8, 10, 12, 18 and 24-in. sewer pipe, also T's and Y's, as needed during year; also hauling and laying. J. B. Keckeley, supt. sts.

New Orleans, La.—Bids are wanted at noon May 8 for 80 mis. of sewers, 8 to 27 in. diam., 5 to 16 ft. depth, 700 manholes, 325 flush tanks in 4 contracts. F. S. Shields, secy. G. G. Earl, gen. supt., Sewerage and Water Bd.

Buffalo, N. Y.—Bids are wanted at 11 a. m. April 5 for 18 and 15-in. tile sewer in Cochrane st., 10-in. tile sewer in Dutton ave., 5-ft. brick sewer in Virginia st. and 12 and 10-in. tile sewer on both sides of Dorchester road.

Pensacola, Fla.—Bids are wanted at noon April 15 for 43 mis. of brick, iron, terra cotta and concrete sewers and drains, 8-in. to 8-ft. drain. Estimated cost, $250,000. L. Hilton Green, chmn. Bd. Bond Trustees. T. Chalkley Hatton, cons. engr., Wilmington, Del.

CONTRACTS AWARDED.

Boston, Mass. — The following sewer contracts have been awarded: Michael Leonard, Center street, $3,700; John E. Burns, Orchard pk., $2,100; J. J. Coughlan Construction Co., Winslow st., $2,700; Geo. J. Reagan, Fremont pl., $4,100; P. McGovern, St. Stephens st., $9,000; John Slattery, Munroe st., $3,000; John McMorrow, Fessenden st., $2,300; Dennis S. Ryan, Walk Hill st., $2,100; Wm. L. Dolan, private land, $2,200; Geo. J. Regan, Harold st., $3,100; Connolly & Graham, Devon st., $3,700; Wm. J. Barry, Westland entrance, $4,000; John Slattery, Geneva ave., $3,700; John E. Burns, Howard ave., $3,500; John A. Rooney, Florence st., $4,700; P. Brennan & Co., Fremont st., $2,300; D. E. Coleman Co., Malcolm st., $2,167; Peter Gilligan, Maple st., $3,096; Thos. J. Shea, Avalon road, $2,495; John McMorrow, Morton st., $5,200; Jas. W. O'Brien, Rockville st., $2,100; Geo. M. Byrne & Co., Florence-st. brook, Sec. 2, $3,900; Robert Eager, Walnut ave., $2,100; Wm. L. Dolan, Canterbury st., $2,800; John T. Shea, Jr., Folsom st., $2,100; Jas. McGovern, Adams st., $2,400; J. J. Coughlan Construction Co., Holworthy st., $3,100; Connolly & Graham, Stanwood st., $3,500; Chas. J. Jacobs, Wachusett st., $3,800; Chas. W. Kinney, Chilton road, $2,078.

Wheeling, W. Va.—Contract was awarded to Walker B. Stratton for sewer pipe for 1906.

Newark, N. J.—Aaron Ward was lowest bidder on the Fine ditch sewer at about $85,000.

Gainesville, Fla.—T. H. Beeman, Louisville, Ky., was awarded contract for building sewers at $45,231.

St. Petersburg, Fla.—Ferguson & Purcell, Lorain, O., have been awarded contract for sewers at about $16,000.

Middletown, O.—J. Arpp, Jr., Middletown, was lowest bidder on Yankee road sewer at $6,207.03

Utica, N. Y.—John Siegrist has been awarded contract for Genesee-st. sewer at $3,353. Paul Schultze, cy. engr.

Jacksonville, Fla.—Bryan & Co. were awarded contract for 50,000 ft. of drain in Main st. at $105,243. J. H. Harris received contract for 50,000 ft. of sewers at $67,664.

Washington, D. C.—Sullivan Bros. were awarded contract for outlet section and tide gate chambers of 4½-st. high-level intercepting sewer; total, $25,268.

Mt. Carmel, Pa.—DeNallo & Klingberg, Kingston, N. Y., were awarded contract for 28,000 ft. 8-in. to 24-in. sewer and appurtenances for $39,039.

Oklahoma City, O. T. — Chas. Derr, Guthrie, was awarded contract for sewer system at $193,000 for 7 sections, and Jos. Severns, Guthrie, for 8th section at $34,121.

Davenport, Ia.—The People's Construction Co. was the lowest bidder on the big Northwest Davenport sewer at 87 2-5 cents a foot, on Sheridan-st. sewer at 82½ cents, and on Libby-ave. sewer at 82½ cents.

WATER WORKS.

Chicago, Ill.—This city is made defendant in a suit filed in the U. S. Circuit Court March 26 for damages for $100,000 for constructing a water tunnel from the

lake to the west side, which resulted in sinking certain pieces of real estate near Harrison st. and 5th ave. The tunnel was built in 1903 and 1904.

Knoxville, Tenn.—This city is considering a proposition made to it March 6 by the Knoxville Water Co., offering to sell its plant to the city for $1,130,000.

West Duluth, Minn.—Aldermen Foubister, Chas. Kauppi and L. J. Nordheim have been appointed a committee to secure the extension of the water and gas mains.

Columbus, O. — The State Board of Health has appointed a committee to inspect every sanitary plant and water-works system in the State of Ohio and report on the condition of the same.

Shelby, O.—The plant of the Shelby Water Co. has been sold to Wm. Bancroft, Meller & Co., bankers, of Philadelphia, for $150,000. Press reports state that this firm of bankers has purchased 15 other water plants in different parts of the country and will merge them into one big company.

Pittsburg, Pa.—We are advised that work on the filtration plant will be pushed as rapidly as possible as soon as the weather moderates. A large amount of concrete work is still unfinished, and it is estimated that approximately 300,000 barrels of cement will be used during the coming summer. It is also said that about 150,000 barrels of cement will be used in connection with the construction of the National Tube Co.'s plant.

CONTEMPLATED WORK.

Malone, N. Y.—This town voted to construct a municipal water-works system.

Manchester, Va.—This city contemplates building a filtration plant soon.

Hattiesburg, Miss.—Bids will be asked soon for water-works and sewer improvements.

Ballard, Wash.—Plans are being prepared for erecting a steel tower. J. Bostian, cy. engr.

Fremont, Neb.—This city will vote April 3 on the issue of bonds for water-works extensions.

Washington, D. C.—The District commissioners have authorized the laying of four water mains.

Seneca Falls, N. Y.—Plans are being discussed for building a municipal water system.

New Castle, Del. — The New Castle Water Works Co. will expend $50,000 in remodeling its plant.

Fostoria, O.—A 1,200,000-gal. filter will be installed here. Riggs & Sherman, engrs., Toledo, O.

Anglesea, N. J. — Council has appropriated $50,000 for the construction of a water-works system.

Topsham, Me. — F. C. Whitehouse is chairman of a committee appointed to install water works.

Harrisburg, Pa.—Water mains are to be laid in a large number of streets. M. B. Cowden, cy. engr.

Muskegon, Mich.—Contracts will be let soon for constructing an entirely new water-works system.

Casey, Ill. — A standpipe and power pumping plant is contemplated in connection with the new water-works system here.

Hastings, Mich.—This city will issue $35,000 bonds for the extension of water works. J. M. Patten, cy. clk.

Dixfield, Mo.—The Dixfield Electric and Water Co. has decided to construct a gravity water system this year. John A. Decker, prest.

Oxford, Mass.—The Oxford Water Co. contemplates the construction of water works at an estimated cost of $30,000.

Escanaba, Mich.—The Escanaba Water Co. is reported as contemplating the construction of a filtration plant.

Asbury, N. J.—The citizens voted March 19 to issue bonds for constructing a system of pipes and pumping plant.

Grand Rapids, Mich.—The question of issuing $125,000 bonds for water-main extensions will be voted on in April.

Medina, O.—Plans for a water-works and sewerage system will be prepared by E. G. Bradbury, C. E., of Columbus.

Sinclairville, N. Y. — Special.—E. B. Mitchell desires the names of firms manufacturing water meters for power purposes.

Saginaw, Mich.—The question of issuing bonds for the construction of a new water-works system will be voted on April 2.

South Amherst, Mass.—Plans are being prepared for the extension of the Amherst Water Co.'s system to this city, at a cost of $18,000.

Cleveland, O.—The village of Newburg has voted to issue $44,000 bonds for the extension of the city water system to that place.

Cape May, N. J.—Bids will probably be asked in April for laying 9,000 ft. of water mains, 5 hydrants, etc. D. D. Barlow, cy. engr.

Waukesha, Wis.—City Council passed an ordinance March 6 providing for the issue of $70,000 bonds for a municipal water-works system.

Trenton, Mo.—This city voted to issue $80,000 bonds for either buying and improving the present water-works plant or building a new one.

Norfolk, Va.—The construction of a 16-in. water main to the grounds of the Jamestown Exposition is contemplated. W. T. Brooke, cy. engr.

Saltillo, Coahuila, Mex.—Special.—T. S. Abott (Ingeniero del Estado) desires the address of manufacturers of water meters for domestic use.

Ann Arbor, Mich. — Common Council unanimously passed a water-works ordinance March 12, in conformity with the recommendations of the citizens' committee.

Tecumseh, O. T.—City Council has engaged the O'Neil Engineering Co., of Dallas, to make plans and specifications for the proposed water-works system here.

The question of issuing bonds for constructing water works will be voted on as follows: Ardmore, I. T., April 7; Hagerstown, Ind., and Waukesha, Wis., April 3; Athens, Mich.,

Pekin, Ill.—The City Council has received a proposition from a company of capitalists, represented by Albert Weiss and Geo. H. Lucas, of Peoria, agreeing to build a water-works plant here.

Hummelstown, Pa.—The Hummelstown water plant and the Hummelstown electric light plant have been purchased by Allen K. Walton, of this city, who will install larger dynamos and make other improvements.

The construction of water-works systems is contemplated at the following places: Denver, Ia.; Anglesea, N. J.; Crewe, Va.; Carthage, N. C.; Adairsville, Ga.; North Birmingham, Ala.; Breaux Bridge, La.; Roff, I. T.; Sunnyside, Wash.;

Springfield, Ore.; Price, Utah; Atoka, I. T.; Artesia, N. M.; Dickinson, N. D.; Arlington, S. D.; Lewistown, Mont.; Billings, Mont.

Cincinnati, O.—Bids will be received about April 27 for special pumps for flushing the settling basins and cleaning the filter beds. W. W. Comrs. An investigation of the price of water meters is also proposed.

Tacoma, Wash.—The question of the Green river gravity water supply will be voted on in April. The measure provides for the construction of a gravity system with a capacity of 40,000,000 gals., at a cost of $1,650,000.

Barre, Mass.—C. H. Follansby, J. A. Rice, Harding Allen, A. G. Williams and others have been appointed a committee to investigate the construction of a waterworks system and report at an adjourned town meeting April 2.

The question of issuing bonds for constructing water works has been favorably voted on at the following places: Lyndhurst-Kingsland, N. J.; Victor, N. Y.; Marietta, Tex.; La Junta, Col.; Marshall, N. C.; Live Oak, Fla.; Amherst, N. B.; Rochester, Mich.; Hancock, N. H.; Aurora, Minn.; Biwabik, Minn.

Warsaw, Ind.—The water-works system here has been sold under foreclosure of a mortgage for $18,000 over and above the mortgage of $100,000. The bondholders obtained a clear title and will transfer the property to the Winona Assembly, which is to make additions to the system and supply water to the town and assembly from wells on the assembly grounds.

Bridgewater, N. J.—Special.—Frank L. Hewitt, cy. recorder, says this city has a steel tank 100 ft. in diameter, with brick and cement foundation and bottom. Only about one-half of the tank can be used, as the foundation will not stand the water pressure. The water committee is about to recommend the lining of the tank with concrete to the top, using the steel for backing. It will be given out by contract. Thos. H. Woodruff, chmn. w. w. com. and prest. Council.

Bangor, Me. — Freeman C. Coffin, of Boston, has submitted to Mayor Peirce and the City Council a report on possible sources of water supply for this city other than the Penobscot river. His suggestions include the following: A ground water supply at a cost of $100,000 to $150,000 and an annual maintenance of from $7,000 to $11,500, according to conditions only disclosed by experiment to be made in such a case; a supply from Phillips lake, at a cost of $350,000 to $475,000, according to method of filtration, and an annual maintenance cost of $16,750 to $26,000; a supply from Felt's and Eaton's brooks, locally known as Burr brook, entering the Penobscot opposite the pumping station, at a cost of $135,000 to $250,000 and annual maintenance of $12,000 to $16,000; Cold Stream pond, which would cost $1,100,000 and an annual cost of $52,130, assuming the formation of a Penobscot water district; otherwise the cost of the two would be $1,400,000 and $64,000, respectively.

CONTRACTS TO BE LET.

Sebastopol, Cal.—Bids are asked until April 3 for constructing water works. Mayor.

New York City.—Bids are asked until April 4 for pig lead, cocks, nozzles, water pipe, special castings, gate valves and for the construction of water mains in a large number of streets. Wm. B. Ellison, comr. water supply, etc.

Yonkers, N. Y.—Bids are asked until April 12 for an 8,000,000-gal. pump. J. J. Devitt, prest. bd. w. w. comrs.

Orange, N. J.—Bids are asked until April 9 for furnishing and laying 20-in. c. i. pipe and specials. Fred T. Crane, cy. engr.

Washington, D. C. — Sealed bids are asked until April 13 for the extension of the water distribution system at Fort Myer, Va. Capt. A. W. Butt, Q. M.

Columbus, Ind.—Bids are asked until April 16 for constructing a wooden infiltration gallery 210 ft. long in White river. W. H. Rights, cy. engr.

Philadelphia, Pa.—Bids are asked until April 26 for pumping engines, pumps, boilers, etc., for Torresdale filters. Thos. L. Hicks, dir. pub. wks.

New Orleans, La. — Sealed bids are asked until May 15 for furnishing and laying 100 mls. of c. i. water pipe and about 10,000 tons of 4 to 24-in. special castings. F. S. Shields, secy. sewerage and water bd.

Salt Lake City, Utah.—Sealed bids are asked until April 11 for constructing all water mains that may be ordered during the year, consisting of 30,000 lin. ft. 6-in., 3,000 ft. 8-in. and 800 ft. 10-in. pipe, including excavating, special castings, hydrants, valves, etc. Fred J. Leonard, chmn. B. P. W.; Louis C. Kelsey, cy. engr.

CONTRACTS AWARDED.

Springfield, Mass.—The contract for intermittent filters was awarded to F. T. Ley & Co., of this city, for $12,493.

Minooka, Ill.—The contract for constructing a water-works system was awarded to P. C. Fletcher, of Blue Island, for $10,650.

Cincinnati, O.—The contract for electric generating machinery for the eastern pumping station was awarded to Dravo, Doyle & Co., for $28,692.

Rahway, N. J.—The Federal Filtration Co., 14 Broadway, New York city, has been awarded the contract for a filter plant and standpipe for $51,350.

Wynnewood, I. T.—The contract for constructing a water-works system and electric-light plant was awarded March 10 to N. S. Sherman, of Oklahoma City, for $26,046.

Lorain, O.—The contract for constructing three coagulant tanks at the new water-works plant was awarded March 8 to the Pittsburg Filter and Mfg. Co., of Pittsburg.

Rochester, N. Y.—The contract for furnishing water pipe and castings for the current year was awarded to the U. S. Cast Iron Pipe and Foundry Co. for $73,789.

Belle Plaine, Ia.—Special.—The contract for constructing a water-works system here was awarded March 23 to T. C. Brooks & Son, of Jackson, Mich., for $17,654.29, which included everything except the contract for the tower and tank, which was awarded to Merrideth & Brandenburg, of Cedar Rapids, Ia., for $15,332.49.

East Liverpool, O.—Contracts for supplying materials were awarded March 7 as follows: Pipe, Clow & Sons, of Newcomerstown, $27.95 per ton for 10 and 16-in. pipe; special valves, Bourbon Copper and Brass Co., of Cincinnati, $12.50 for 6-in., $26.50 for 10-in. and $67 for

16-in. valves, and $73 each for 2 geared valves; pig lead, Bailey-Farrel Mfg. Co., of Pittsburg; yarn, Hartley-Rose Belting Co., 5 cents per pound.

Youngstown, O.—Contracts for waterworks supplies, involving expeditures of more than $20,000, were awarded March 6 as follows: Meters, Pittsburg Meter Co., Pittsburg, Pa.; valves, Darling Mfg. Co.; hydrants, R. D. Wood & Co.; pipe and specials, Massillon Iron and Steel Co.; curb boxes and corporation cocks, Farnan Brass Co.

BRIDGES.

Dayton, O.—A new river bridge to connect 1st st. and Salem ave. is contemplated.

Excelsior, Minn.—A new bridge across the outlet to St. Albans bay has been decided upon.

Frankfort, Ind.—Bids are asked until April 2 for constructing 21 concrete bridges. Co. audt.

Charleston, S. C.—The Klaren Bridge Co. has been incorporated to construct a toll bridge across Wapoo Cut.

Exeter, N. H.—This town voted to build a bridge over Little river at Gilman Park. Fred S. Fellowes, town clk.

Portland, Ore.—Plans and specifications are being prepared for a steel bridge across Sullivan gulch at Grand ave.

Milwaukee, Wis.—A bascule bridge over the Kinnickinnic river at Kinnickinnic ave. is contemplated by this city.

Toronto, Ont.—The city engineer estimates the cost of constructing a bridge across the Don at Wilton ave. at $70,000.

Duluth, Minn.—About $25,000 will be expended in remodeling the Lake-ave. viaduct by the Northern Pacific Railroad Co.

Michigan City, Ind.—Council has under consideration the construction of a bascule bridge across the harbor at Franklin ave.

Beverley, Mass.—A draw bridge over the Danvers river will be constructed by the towns of Sales and Beverly. W. J. Berry, cy. engr.

Harrisburg, Pa.—The Board of Public Works will have plans prepared for a steel bridge 1,500 ft. long over Mulberry st. M. B. Cowden, cy. engr.

Clinton, Ia.—Sealed bids are asked until April 3 for constructing all pile bridges in Clinton county. Frank W. Leedham, co. audt.

McKeesport, Pa. — Plans for a new bridge across the Youghiogheny river at 15th ave. have been prepared by Herman Loube, of Pittsburg.

Cleveland, O. — Bids are asked until April 4 for constructing several steel and concrete bridges in Cuyahoga county. W. H. Evers, co. engr.

Paducah, Ky.—Council contemplates the construction of a stone and concrete bridge over Island creek at 4th st. L. A. Washington, cy. engr.

Mishawaka, Ind. — The county comrs. will ask for an appropriation of $75,000 to build a steel and concrete bridge here. M. B. Russ, co. comr.

Chattanooga, Tenn.—The contract for the stone work of the proposed bridge on 11th st. over the Belt tracks was awarded to the West Construction Co. for $10,271.

Portsmouth, O.—The county commissioners have decided to build a new steel bridge across the Brushy Fork of Little Scioto river at Mohat's ford. The commissioners have also decided to take out the sewer fill at the mouth of Brewery Hollow and replace it with a new 8-ft. iron bridge extending across the road.

St. Paul, Minn.—The Park Board has approved the proposition of the Northern Pacific to build a steel and concrete bridge over the Lexington-ave. boulevard.

Cincinnati, O. — Plans are being prepared, according to press reports, for a steel viaduct 200 ft. wide and 50 ft. long. Chas. N. Dannenhower, ch. engr., B. P. S.

Niagara Falls, N. Y.—Bids will be asked at once for the construction of a bridge over the hydraulic canal at 3d and 4th sts., Erie ave. and East Falls st.

New York City.—The proposed Hendrik Hudson Memorial Viaduct bridge, with the approaches on Riverside drive extension included in the plan, will cost about $5,000,000.

New London, Conn.—Bids will be asked soon for building a new reinforced concrete and steel bridge over Winthrop's cove at Crystal ave. Geo. K. Crandall, cy. surv.

O'Neil, Neb.—Bids are asked until April 7 for building a bridge across the Niobrara river, between Holt and Boyd counties, near Parshall's crossing. W. R. Simer, clk., O'Neil, Holt co.

Corpus Christi, Tex.—The counties of Neuces and San Patricia will vote April 7 on the issue of bonds for erecting a bridge over the Neuces river. C. H. B. Von Blucher, co. surv. of Neuces co.

Cleveland, O.—Councilman Zinner has announced that $300,000 to $350,000 will be expended in the establishment of a semi-high-level bridge through the upper flats, connecting Clark with E. Clark ave.

Perth Amboy, N. J.—Bids are asked until April 2 for constructing an iron plate-girder bridge on pile timber abutments on Sheridan st. over the Raritan North Shore R. R. Wm. Fullerton, ct. comr.

Lawrence, Mass.—City Council contemplates appointing a commission to recommend a plan and report on the estimated cost of constructing a bridge over Merrimack river. Arthur C. Marble, cy. engr.

Pittsburg, Pa.—Director E. J. McIlvain, of Allegheny, has suggested the building of an immense bridge to span the Allegheny river from a point near the Exposition buildings to Coleman st., with an elevated approach spanning the B. & O. tracks and yards, Rebecca, Lacock, Ann, Robinson and Killbuck sts., the approach to extend to Coleman st. by Monument hill. He also recommends a bridge over the Allegheny a short distance above the Pittsburg, Ft. Wayne & Chicago railroad structure, in the vicinity of Madison ave. or Walnut st.

STREET LIGHTING.

Lexington, La.—Board of mayor and aldermen propose to issue $22,500 bonds for erection of a municipal electric-light plant.

Wynnewood, I. T.—Contract for building electric-light ystem was awarded to N. S. Sherman, Oklahoma City.

Homer, La.—Franchise granted to Sawyer & Ruston to install electric-lighting system.

Sharon, Pa.—Special.—Sealed bids will be received for the purchase of 25 or more gas lamps complete for street purposes. O. J. Denny, secy. borough of Sharon.

Monroe, Mich.—Will issue bonds for $8,500 for lighting-plant extensions April 2.

Middleboro, Mass.—Municipal electric-light plants will probably be enlarged.

Natchez, Miss. — Will probably issue bonds for $75,000 to build electric-light and power plant.

Niles, O.—Bonds for $12,000 have been issued for improvement of electric-light plant. B. L. Logan, cy. audt.

Calgary, N. W. T.—Council will spend $30,000 for electric-light extension.

Shirley, Ind.—Company has been formed to construct electric-light and water-works plants. C. W. Bouslog, prest.

Maryville, Mo.—Council is considering ordinance for issue of $30,000 municipal lighting bonds.

Reno, Nev.—Council authorized N. E. Wilson, mayor, to appoint committee to investigate question of establishing a municipal electric lighting plant.

Hubbard, Tex.—Bids will probably be asked May 1 for erection of ice and light plant to cost $35,000. W. A. Bass, mgr.

Pasadena, Cal.—Bonds for $125,000 are proposed for constructing municipal lighting plant. J. D. Allin, cy. engr.

Salt Lake City, Utah.—Bids will probably be received about May 1 for electric plant to cost about $600,000. Frank G. Kelsey, engr.

Columbus, O.—Bill is reported to have been passed appropriating $25,000 for installing electric-light plant in State House.

Will vote: Saginaw, Mich., April 2.

Voted: Kingstree, S. C., March 15; North Birmingham, Ala., March 5; Oberlin, Kan.; Seattle, Wash., $600,000 for extensions.

Goshen, Ind.—A $1 gas company is promised.

Dunbar, Pa.—Wants electric light.

Chaumont, N. Y.—Is agitating village lighting by electricity.

Phelps, N. Y.—Has voted $2,200 a year for electric lighting of streets.

Marion, Ind.—A new dynamo is needed in the electric-light station.

Columbia, S. C.—Will have a $40,000 Pintsch gas plant to supply gas to railway cars.

Theresa, N. Y.—This village has been authorized to establish a municipal lighting plant.

Cleveland, O.—Ordinance for ash and refuse collection system has passed City Council.

North Attleboro, Mass.—Town meeting has voted $35,000 to enlarge municipal electric-lighting plant.

Palestine, Tex.—Work has begun on new gas plant. J. H. Fitzgerald, Houston, is interested.

Milwaukee, Wis. — Site for municipal electric-lighting plant has been selected.

Salt Lake City, Utah.—The Utah Gas and Coke Co. has begun construction of its plant.

Terre Haute, Ind.—The City Council is considering a municipal electric-lighting plant.

Winchester, Mass.—A committee has been appointed to study municipal electric-light question.

Versailles, Mo.—Voted $5,000 issue of bonds to complete municipal electric-light plant.

Carberry, Man.—Voted almost unanimously to spend $15,000 to build electric-light plant.

Goodland, Kan.—The Goodland Light, Heat and Power Co. has been granted a state charter, capital $50,000, to build electric-light plant.

Alexandria, Va. — Councilman Albert Bryan is trying to lease the electric-light plant to a company.

Fort Wood, New York Harbor.—Bids are wanted at 11 a. m. April 16 for an electric-light and power system.

Niagara Falls, N. Y.—Supt. Edward Perry, of the Niagara Reservation asks $12,000 appropriation for the electric-lighting system.

West Newbury, Mass.—A joint electric-light plant with Georgetown and Groveland and other towns is under consideration.

Raymond, N. H.—Town meeting voted $1,000 a year for electric lighting of streets, selectmen to make contract.

Eldorado, Kan. — Franchise has been granted the Eldorado Light, Heat, Ice and Power Co. for electric lighting.

Tiverton, Mass.—Appropriation of $500 has been made for 25 acetylene gas lamps for street lighting.

Eureka Springs, Ark.—A 99-year franchise for electric light has been granted G. U. Matthews and C. M. Barns.

LaCrosse, Wis.—The LaCrosse Water Power Co. has been incorporated, capital $5,000,000, to generate and distribute electricity.

Troy, N. Y.—Bill has been introduced in Legislature authorizing issue of $500,000 bonds for municipal electric-lighting plant.

Mineral Wells, Tex.—A 50-year franchise has been granted to a San Antonio gas company, plant to be in operation in 6 months.

Irwin, Pa. — A large electric-lighting plant to supply towns from Wilmerding to Derry along Pensylvania railroad is proposed, costing $500,000.

Richmond, Ind. — Mayor Zimmerman has received an offer to purchase the municipal electric-light system for $250,000.

Little Rock, Ark.—C. H. Geist, Spokane, Wash., owner of the local gas plant, will extend mains and probably enlarge works.

Sandy, Utah. — Council is considering proposition of Utah Light and Railway Co. for arc lighting at $11.25 per lamp per month.

Buffalo, N. Y.—Council committees on laws and legislation are holding hearings on municipal electric lighting proposition voted for by people at last election.

Penn Yan, N. Y.—The Associated Gas and Electric Co. has been incorporated with $1,500,000 capital to make and sell gas and electric apparatus and construct plants, etc.

Hutchinson, Kan.—New lighting contract adds 50 lights, making a total of 100 at $75 each, all lamps to be new inclosed arcs.

Garrett, Ind. — Council has granted franchise for fuel and lighting gas at $1.35 a thousand to the Wayne General Construction Co., of Ft. Wayne, Ind.

Cleveland, O.—Contract for 200 arc lights was awarded to Adams-Bagnall Co. by municipal lighting plant. Ordinance is under consideration to appropriate $40,000 for enlargement of plant.

Lake Placid, N. Y.—This village has been authorized to establish a municipal electric-lighting plant. Paul Smith's Electric Light and Power Co. has been authorized to do business in other towns in Essex county.

Tecumseh, O. T.—The O'Neill Engineer-

ing Co., Dallas, Tex., is making plans for water works and electric-light plant, and an election to vote $60,000 bonds for building will be held May 8.

Tallapoosa, Ga.—Bond issue of $3,000 has been confirmed and work will soon begin on new electric-light plant. Bids are wanted for material and labor on plant and side-track to it.

Woodbury Heights, N. J.—The Woodbury Heights Gas Co. has been incorporated to construct water and gas works; capital, $5,000. J. Mayhew, E. T. Waddell and D. D. Marrell, Woodbury Heights, are among the incorporators.

Muskogee, I. T.—Has granted franchise for electric-lighting plant to W. L. Reeves, A. W. Robb, W. N. Patterson, G. W. Barnes, J. Lee Dabbe, etc. This makes 2 electric-light franchises and 2 gas franchises, one of each now in operation.

Abingdon, Ill.—Council has given a 25-year franchise to the Abingdon Electric Co. for a gas plant, to begin with 4 mis. of mains, maximum price of gas to be $1.50 a thousand cu. ft. and city to have free gas or electric light for city building, library and park.

Canaan, N. H.—An electric-light plant is contemplated.

Cuba, Ill.—A municipal electric-light plant is contemplated.

Kingstree, S. C.—The citizens voted to issue bonds for constructing an electric-light plant.

Dunbar, Pa.—The question of establishing a municipal electric-light plant is being agitated.

Osage City, Kan.—The citizens voted March 16 to issue bonds for improving the electric-light plant.

Portland, Ore.—The city engineer has been directed to prepare plans for an underground conduit system.

Eugene, Ont.—Bids will be received in May for constructing a power plant here for the Georgian Bay Power Co.

Halifax, N. S.—A special committee is considering the advisability of installing a municipal electric-light plant.

Waycross, Ga.—Bids will probably be asked at once for a gas plant. J. Edw. Dempsey, gen. mgr. Waycross Gas Works.

Grand Island, Neb.—Bids will be received about April 14 for constructing an electric-light plant. W. K. Palmer, cons. engr., 718 Dwight bldg., Kansas City, Mo.

Philadelphia, Pa.—Bids are asked until April 3 for lighting the incandescent lamps and furnishing lamp posts in this city during the year. Thos. L. Hicks, dir. pub. wks.

Chipley, Ga. — Col. T. T. Murray is chairman of a committee of citizens appointed to ascertain the possibility of organizing a company to construct water works and an electric-light plant.

Templeton, Mass.—The committee appointed to investigate the electric-light proposition has reported in favor of establishing a municipal light plant, the power to be procured from the Gardner Electric Light Co.

Dothen, Ala. — Contracts have been awarded for the municipal electric-light plant as follows: To the Crocker-Wheeler Co., of Ampere, N. J., for dynamos; the Harrisburg Machine and Foundry Co., Harrisburg, Pa., for the engines, and the Adams-Bagnall Electric Co., of Cleveland, O., for alternating arc lights.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

Wilmington, Del.—City Council will ask for bids for removal and destruction of garbage.

St. Louis, Mo. — Committees of the councils in March visited Cleveland, Toledo and Chicago inspecting garbage-disposal plants.

Marion, O.—It is reported that bids will be received April 4 for collecting and hauling garbage.

Marietta, O.—Board of Public Service has asked City Council to appropriate $1,000 to buy street flusher.

Zanesville, O.—Members of Council and Board of Public Service inspected garbage crematory at Canton, March 15.

Barberton, O. — Health Officer Rodebaugh recommends use of traveling garbage crematory.

New Orleans, La.—The sum of $3,000 is needed for purchase of sweepers, wagons and mules to keep St. Charles ave. clean.

Lorain, O.—Board of Public Service will advertise at once for bids for collection of garbage.

Houston, Tex.—It is reported that a garbage crematory will be installed at a cost of but $500.

Mobile, Ala.—Council is considering a proposition for disposal of garbage by reduction process.

Harrison, N. J.—Richard Green was awarded contract for collecting garbage, ashes, etc., at $2,000 a year.

Dayton, O.—Contract for construction of garbage loading station was awarded March 20 to F. A. Requarth Co. at $5,733.

Racine, Wis.—The City Council voted March 9 to contract with the Decarie Garbage Incinerating Co., of Minneapolis, Minn., for a garbage crematory at $17,000.

Seattle, Wash.—Ordinance has passed Council appropriating $30,000 for municipal garbage crematory. Cy. Engr. Thomson will draw plans.

Bloomington, Ill. — Bid of Lewis & Kitchen of $12,911 for building garbage crematory was referred March 16 to Board of Local Improvements for action.

Wheeling, W. Va.—Contractor has refused to accept contract at price of $15,300 for hauling garbage, and bids will probably be readvertised.

Los Angeles, Cal.—McClure & Maguire are new garbage collection contractors and have purchased wagons, beginning work April 1.

Marion, O.—Bids are wanted at noon April 4 for rates at which contractor will remove garbage, rubbish, night soil, dead animals, etc., for citizens for one year.

Chicago, Ill.—Committee of Council has been appointed to prepare specifications for erection of new municipal plant for disposal of city's garbage.

Columbus, O.—Bond ordinance is in City Council to raise money to build $290,000 garbage disposal plant. The Toledo Development Co. offers to dispose of garbage at $12,000 a year.

Grand Rapids, Mich — The municipal collection of garbage, with cost of equipment, is estimated at $15,000. There is a proposal by Brown & Dowling to dispose of the garbage without cost to the city.

WHAT DO YOU WANT ?

Are you seeking Employment

Have you second-hand Machinery for Sale

Do you want Machinery or Supplies

Do you want men for Employment

A **"Want"** advertisement in MUNICIPAL ENGINEERING will be the most thorough, the least expensive and the surest way of finding the opportunity you seek. Rate 1½ cents per word each insertion; minimum charge, 50 cents.

WANTED—Superintendent and foremen for asphalt paving and general contract work in Central West. THE PARKER-WASHINGTON CO., Chamber of Commerce, Chicago.

AGENTS WANTED—To solicit contracts for a street, road or pavement possessing many advantages over our present roads. New in this country, but successfully laid in Europe for last thirty years. Address, MUNICIPAL, care of Municipal Engineering Co., Indianapolis, Ind.

WANTED—Two second hand steam street Asphalt rollers, first class condition. Address, ASPHALT ROLLERS, care of Municipal Engineering, Indianapolis, Ind.

WANTED—50,000 barrels Portland cement for Chicago, St. Louis and Kansas City delivery this year. Address, Chicago, St. Louis and Kansas City office. THE PARKER-WASHINGTON CO.

WANTED—Six Dromedary concrete mixers, new or second-hand. Must be in good condition. I. I. W., care of Municipal Engineering, Indianapolis, Indiana.

FOR SALE—I have for sale a second hand block machine and a concrete mixer, as I intend to install a bigger plant. JACOB L. JOHNSON, West Union, Iowa.

SEALED PROPOSALS.

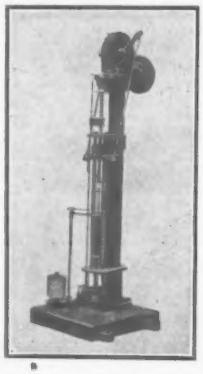
Sealed proposals will be received, up to April 7, 1906, for the construction of about eleven miles of cement sidewalk. Specifications may be obtained of the company. The right is reserved to reject any and all bids. OAKDALE IMPROVEMENT CO., Peru, Ind.

PROPOSALS FOR STREET LAMPS.

Sealed bids will be received at the office of the secretary for the purchase of twenty-five or more gas lamps complete for street purposes. The right is reserved to reject any or all bids.

BOROUGH OF SHARON, PA.

O. J. Denney, Secretary.

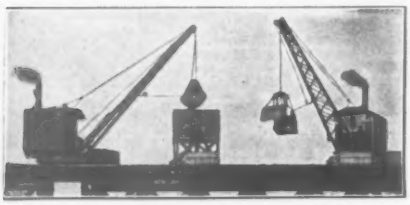


IMPACT TESTS

For Road-building Materials and Cements

INTERNATIONAL INSTRUMENT CO.

Cambridge, Mass., U. S. A.



BROWNING LOCOMOTIVE CRANES

handle coal in large quantities, rapidly. This picture shows the cranes transferring coal from river barge at the rate of 300 tons per hour.

DESCRIPTIVE BULLETINS SENT ON REQUEST

THE BROWNING ENGINEERING CO., CLEVELAND, O.

RUGGLES-COLES DRYERS

For Sand, Clay, Rock, Marl, All Materials

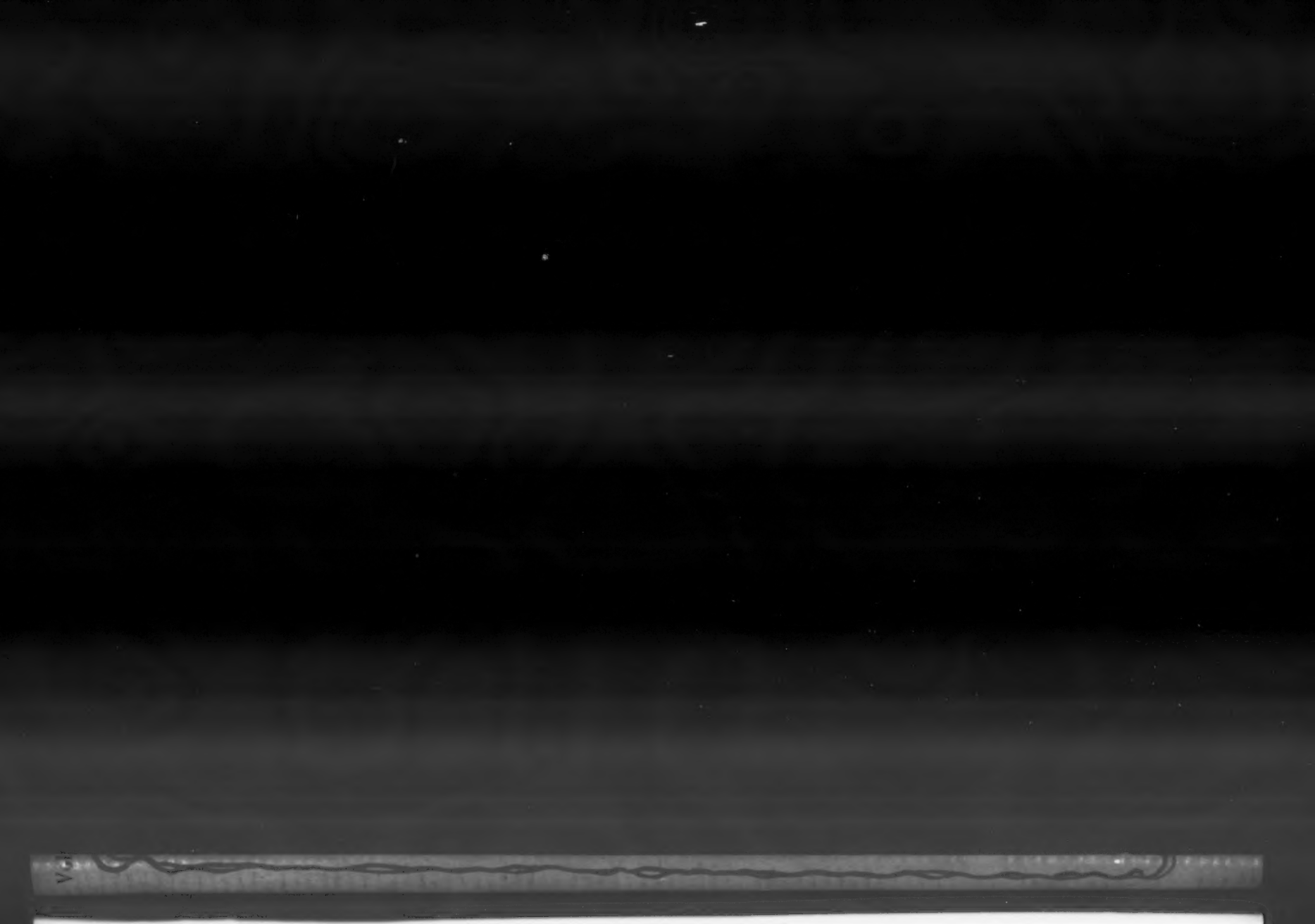
NEW YORK CHICAGO

JUST WHAT HE WAS LOOKING FOR!

EL PASO, TEXAS, March 23, 1906.

MUNICIPAL ENGINEERING CO., Indianapolis, Ind.:

Gentlemen—I have read MUNICIPAL ENGINEERING with great pleasure and I trust great profit. I consider it a very valuable publication and just what I have been looking for.

I consider it almost indispensable to the contractor who would desire to be abreast of the times and know his business, as well as what progress is being made by the country generally in this particular field of work.

FONCANNON & FRIST.
Per FRANK P. FRIST.